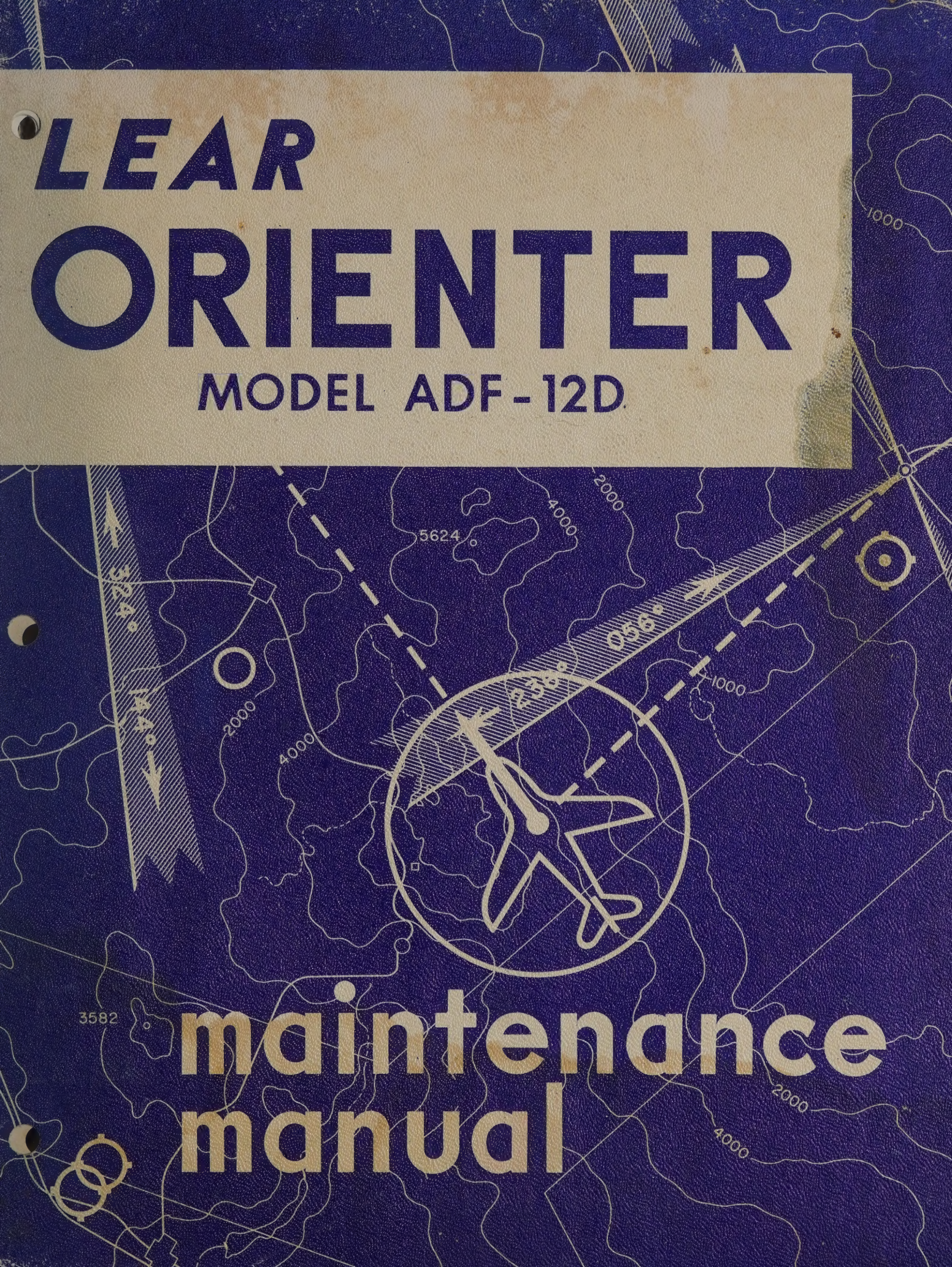
LEAR

ORIENTER

MODEL ADF-12D



maintenance manual

IMPORTANT

As an authorized Lear Service Representative, you have been mailed two copies of this Maintenance Manual. The manual will be kept constantly up-to-date to cover any improvements made in its subject equipment. Revised pages covering any changes in the equipment will be sent to the same address to which this manual was mailed.

Notify Us TODAY if we have mailed your Manuals to a Wrong or Outdated Address.

The comb attached at the end of this card is used for the insertion of revised pages in your manual. To use the comb, proceed as follows:

1. Open the manual to the page that is to be replaced or supplemented.
2. Tear out the old page if the page is to be replaced.
3. Lay the revision page in position with the "T" cut slots overlapping the plastic binding.
4. Comb the page into the binding by resting the comb flat against the revision page and pressing the teeth of the comb gently into place between the spirals of the binding.

Insert Revision Pages immediately upon reception to insure having Correct, Up-to-Date Servicing Information

WHEN YOU NEED IT.

MAINTENANCE MANUAL

for the

ORIENTER

MODELS ADF-12D3, ADF-12D4

AUTOMATIC DIRECTION FINDER

LEAR, INC., *LEARCAL DIVISION*

3171 S. BUNDY DRIVE, SANTA MONICA, CALIFORNIA, U.S.A.

TM 4

TABLE OF CONTENTS

Paragraph	Title	Page
	I - FUNCTION AND DESCRIPTION	1
1	What the Orienter Does	1
2	Description of Components	1
	a. Tuner Unit	1
	b. Direction Indicator	1
	c. Amplifier Unit	1
	d. Loop Antenna	1
	e. Sense Antenna	1
	f. Tuning Meter	2
	g. Connector and Switch Kit	2
3	Technical Characteristics	2
4	Reference Data	2
	a. Manufacturer's Data	2
	b. Differences in Models	3
	c. Equipment Required	3
	II - THEORY OF OPERATION	4
1	General	4
	a. Description	4
	b. Communications Receiver Operation	4
	c. ADF Operation	4
2	Operation as an Automatic Direction Finder	5
	a. General	5
	b. The Antennas	5
	c. The Comparison Circuits	5
	d. System Operation	6
	e. Summary of ADF Operation	8
3	Detailed Theory of Operation	8
	a. Loop Antenna Assembly	8
	b. Tuner Unit	10
	c. Amplifier Unit	10
	III - MAINTENANCE PROCEDURES	12
1	Test and Maintenance Equipment Required	12
2	Trouble Localization Chart	12
3	What to do in Case of "Marginal" Performance	17
	a. Check the Installation	17
	b. Check the Tubes	17
	c. Signal Trace the Equipment	17
	d. When to Align the Orienter	17
4	Voltage and Resistance Measurements	17
5	Signal Tracing Procedures	17
	a. General	17
	b. Audio Output Stage Gain Test	17
	c. Compass Output Stage Gain Test	18
	d. I-F Stage Gain Test	18
	e. R-F Stage Gain Test	20
	f. Loop and Modulator Test	20
	g. Amplifier Phase Shift Test	21
	h. Vibrator Operation Check	22
6	Alignment Procedure	22
	a. General	22
	b. Alignment Connections	22
	c. Dial Calibration Adjustment	22
	d. I-F Alignment	22
	e. Tuner Unit Alignment	22
	f. Amplifier Phase Shift Adjustment	24
	g. Autosyn Transmitter Adjustment	24
	h. Antenna Matching Adjustments	25
	i. Quadrantal Error Correction	26

TABLE OF CONTENTS (Cont)

Paragraph	Title	Page
7	Disassembly and Reassembly of Model 2320 Loop Antenna	28
8	Final Testing	28
	a. Bench Tests	28
	b. Pre-flight and Flight Test Specifications	30
Appendix I	Installation Data	I-A
Appendix II	Parts Lists	II-A

LIST OF ILLUSTRATIONS

Figure No.	Title	Page
1-1	Components of the Lear Orienter Model ADF-12D	iv
2-1	Orienter Simplified Block Diagram	4
2-2	Phase Comparison Circuit, Simplified Diagram	6
2-3	Orienter System Operation, Block Diagram	7
2-4	Phase Relationships in Orienter ADF Operation	9
3-1	Typical Voltages and Resistances, Tuner Unit	18
3-2	Typical Voltages and Resistances, Amplifier Unit	19
3-3	Typical Orienter Modulation Patterns	20
3-4	Phase Shift Pattern as Loop is Rotated Through Null	21
3-5	Vibrator Output Oscilliscope Patterns	21
3-6	Orienter Alignment and Test Connections	23
3-7	Orienter Alignment Points	24
3-8	Model 2320 Loop Antenna, Exploded View	27
3-9	No. 702600 Tuner Unit, Top View	31
3-10	No. 702600 Tuner Unit, Bottom View	32
3-11	No. 702600 Tuner Unit, Side View	33
3-12	No. 702601 Amplifier Unit, Top View	34
3-13	No. 702601 Amplifier Unit, Bottom View	35
3-14.	Orienter Model ADF-12D3, D4 Schematic Diagram	36-37
	Appendix I	I-A
702812	ADF-12D3, D4 Tuner, Installation Data	
64139	ADF-12 Amplifier, Installation Data	
2330	Direction Indicator, Installation Data	
64195	Tuning Meter, Installation Data	

LIST OF ILLUSTRATIONS (Cont)

Figure No.	Title	Page
TM4-2	Loop Antenna, Installation Data	
702809	ADF-12D3 and 4, Interconnecting Wiring Diagram	
63851	Model WA-54 Whip Antenna Installation Data	
703743	Long Wire Antenna Installation Data	
TM6-B1	Bonanza, Recommended Antenna Installation	
TM6-B2	Twin Bonanza, Recommended Antenna Installation	
TM6-P1	Apache, Recommended Antenna Installation	
TM6-R1	Navion, Recommended Antenna Installation	
TM6-C1	Cessna 170, Recommended Antenna Installation	
TM6-C2	Cessna 180, Recommended Antenna Installation	
TM6-C3	Cessna 310, Recommended Antenna Installation	
TM6-D1	Beaver and L-20, Recommended Antenna Installation	
TM6-A1	Aero Commander, Recommended Antenna Installation	
TM6-P2	Tr-Pacer, Recommended Antenna Installation	

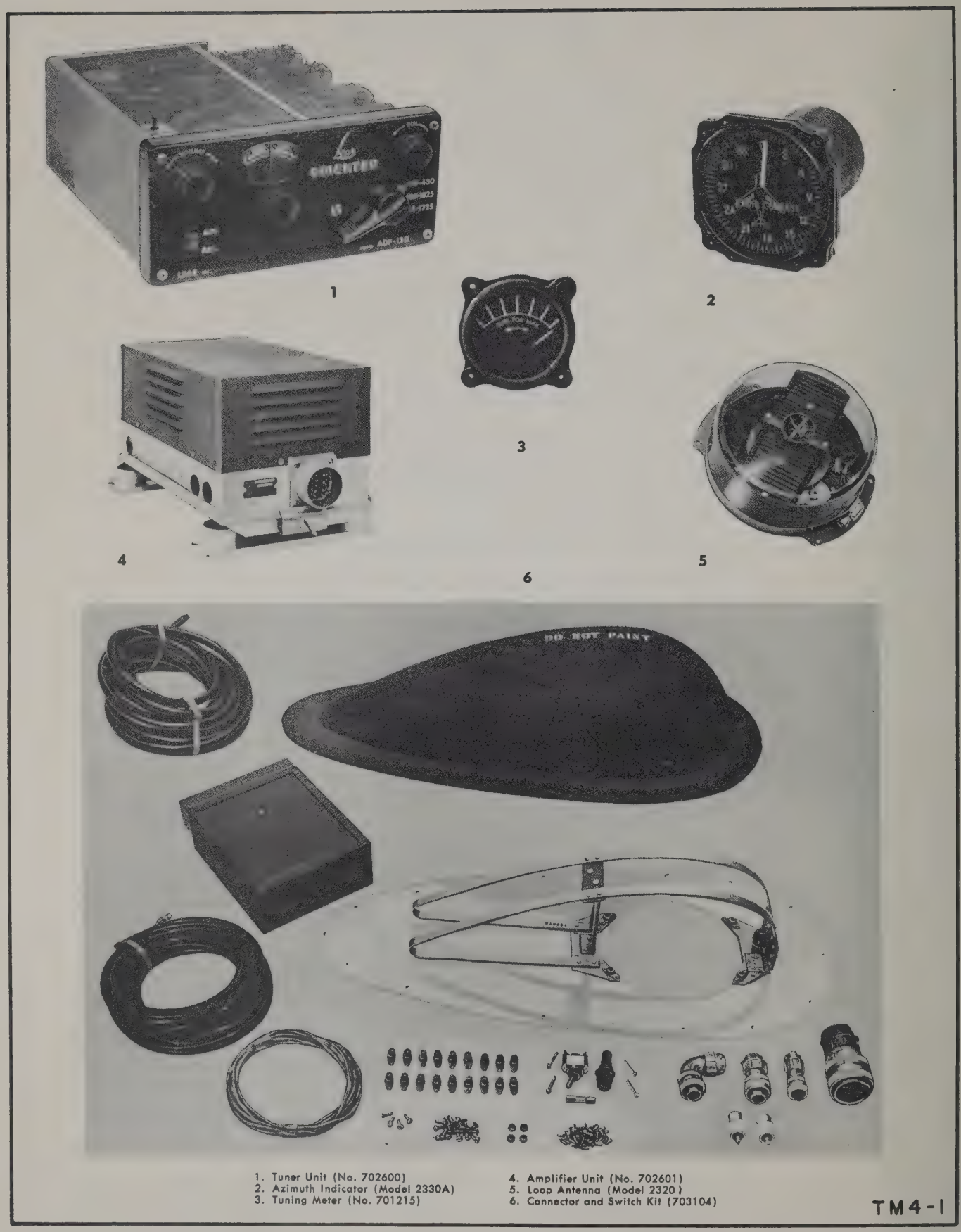


Figure 1-1. Components of the Lear Orienter Model ADF-12D

SECTION I

FUNCTION AND DESCRIPTION

1. What the Orienter Does

The Lear Orienter is a combination automatic direction finder (adf) and Communications receiver. The Orienter covers the following frequency bands:

Frequency Range	Band
190 KC through 430 KC	CAA Low Frequency Range and Tower Band
480 KC through 1025 KC	Lower part of the commercial broadcast band
1025 KC through 1725 KC	Upper part of the commercial broadcast band

The Orienter will receive signals from any station within its frequency range. In its function as an adf, the Orienter may be used to home on a station, or for the purpose of obtaining a position fix. Orienter directional information is displayed on a direction indicator calibrated in degrees of azimuth.

2. Description of Components

There are two basic models of the Orienter, both of which are available in 14 and 28 vdc primary power versions. One model is equipped with a beat frequency oscillator (bfo), the other model is not. In designating models, the standard (without bfo) is always given an uneven number in the current series (ADF-12D3, etc.). The model with bfo is given an even number (ADF-12D4, etc.). Physically the two versions are practically identical.

Each Orienter consists of five elements, their interconnecting cabling, mounting hardware, and installation fixtures. In addition, an inexpensive accessory Tuning Meter is made available at the buyer's option which enables the pilot to obtain more accurate bearings through more accurate receiver tuning.

The operating elements of the Orienter are described below.

a. Tuner Unit

All of the Orienter operating controls (with the exception of an externally mounted on-off switch) are mounted on the Tuner Unit. The Unit is rectangular in shape and is normally mounted in the instrument panel by a single captivated stud which is accessible from the front of the Tuner. Electrically the tuner is the "head-end" of the radio receiver. It contains the r-f amplifying, hetrodyne oscillator, and converter stages of the system. The Tuner connects to the loop antenna, the sense antenna, and the Amplifier Unit upon which it depends for a power supply.

b. Direction Indicator

Several different Lear Direction Indicators are available for use with the Orienter. The indicator provided as standard equipment, however, is the Model 2330A. The Model 2330A is calibrated in degrees and a small airplane printed on the crystal aids the pilot in referencing bearing readings to his aircraft. The indicator mounts in a standard 3-1/8" opening on the pilot's instrument panel. The needle of the indicator is slaved, through an autosyn, to the loop antenna and tracks the motion of the loop exactly.

c. Amplifier Unit

The Amplifier Unit is mounted on its own shock-mount at any convenient point in the aircraft. It contains the vibrator power supply, the i-f strip, detector, avc, audio amplifying, and compass output amplifying circuits of the equipment. The Amplifier Unit is electrically connected to the aircraft primary power source, to the Tuner Unit, and the Loop Antenna motor.

d. Loop Antenna

The Model 2320 Loop Antenna is supplied with the ADF-12D3, D4 series Orienter. This antenna is available in several different models designated the 2320A, 2320B, etc., which define different refinements of the same basic loop. All models of the 2320 are electrically and mechanically interchangeable. The model normally supplied with the Orienter is the Model 2320C.

The loop antenna is usually mounted in a fairing on the exterior surface of the aircraft, or in a nose or tail cone.

The antenna itself consists basically of a wire wound over a powdered iron base to form a loop. In ADF operation, the antenna is rotated by a motor driven through the ADF amplifiers (in the Amplifier Unit) in such a way that the antenna "nulls" (points) in the direction from which signals are being received. An autosyn, mechanically coupled to the antenna, transmits the directional information to the Direction Indicator.

The assembly is particularly resistant to environmental damage, due to the fact that it is hermetically sealed beneath a clear plastic dome. Condensation that might result from exterior pressure changes is prevented by a desiccant capsule which keeps the interior air of the dome dry at all times.

e. Sense Antenna (not shown in figure 1-1)

The form of sense antenna used with the Orienter is not critical, but best results will be obtained with the type recommended in the installation instructions packed with every installation kit. In general, a long wire "L" end-fed from the end nearest the Tuner Unit has proved to give most satisfactory results in both the identification and adf functions of the Orienter. When the equipment is used as a communications receiver, the Orienter receives signals on the sense antenna alone. In adf operation, the sense and loop antennas work together to null the loop in the direction of a received signal.

f. Tuning Meter

The Tuning Meter is an optional accessory. It is used by the pilot as an aid in tuning the Orienter exactly in adf operation to achieve the most accurate results possible. The meter fits a 2-1/4" instrument panel opening and has an arbitrary scale with the direction of maximum signal strength indicated by an arrow.

g. Connector and Switch Kit

The Connector and Switch Kit shown in Figure 1-1 is provided for Orienter installation in aircraft for which no specific Installation Kit is available. The kit contains the connectors, switches, loop fairing, loop base, tuner dust cover, r-f cables, and hardware necessary to install the Orienter in any aircraft.

Installation kits for specific aircraft are also available. These kits contain, in addition to the items supplied in the Connector and Switch Kit, pre-fabricated interconnecting cabling and a sense antenna of the recommended type for the particular aircraft. Whenever possible, an Installation Kit should be ordered in place of the Connector and Switch Kit since the installation is greatly simplified through the use of such a kit.

3. Technical Characteristics

Types of Reception: A-M (Amplitude Modulation)
C-W (Continuous Wave)*

Types of Operation: Communications Receiver
Automatic Direction Finder

Frequency Data: 3 bands
190 through 430 KC
480 through 1025 KC
1025 through 1725 KC
Continuously variable within each band

Weight:
Tuner Unit . . . . . 3.9 lbs
Amplifier Unit . . . 9.2 lbs or 9.5 lbs*
Amplifier Shockmount . . . 1.2 lbs
Loop Antenna . . . . . 3.4 lbs
Direction Indicator. . . . 0.3 lbs**
Connector & Switch Kit . . . . . 8-9 lbs***
Tuning Meter (optional accessory) . . . . . 0.6 lbs

TOTAL WEIGHT (approx, excluding cabling). . . .
Model ADF-12D3. . . . . 27 lbs
Model ADF-12D4 . . . . 27.9 lbs

Over-all Dimensions:

Tuner Unit . . . . . 6-25/64" wd x 2-57/64" h x 9-9/32" dp

Amplifier Unit (including shockmount) . . . . 6-59/64" h x 12" lg x 7-7/8" wd

Loop Antenna (less exterior fairing) . . . . . 7-7/16" lg x 7" wd x 6-3/8" h

Surface Area covered by Loop fairing base . . . . . 24-7/8" lg x 10-7/8" wd

Maximum Depth of Loop Fairing . . . . . 6" ± 1/8"

Direction Indicator. . . . . 3-1/4" h x 3-1/4" wd x 3-13/16" lg**

Tuning Meter (optional accessory). . . . . 2-3/8" h x 2-3/8" wd x 3" lg

Operating Power Requirements:

14 vdc at 5.8 amperes
28 vdc at 3.1 amperes
power consumption . . . . . 86.8 watts (max)

Sensitivity:
As a Communications receiver: 15 uv for 500 mw output

As an Automatic Direction Finder: 30 uv/m for ±3° bearing accuracy

Loop Rotational Speed:
Model 2320C (Standard ADF-12): 180° in six seconds

Audio Output Impedance: 3.2 ohms

* Model ADF-12D4 only
** Model 2330A
***Installation kits vary slightly in weight

4. Reference Data

a. Manufacturer's Data

The Orienter is manufactured by Lear, Inc., LearCal Division, 3171 S. Bundy Drive, Santa Monica, California, U.S.A. Direct all inquiries to the attention of the Sales Department at the above address.

b. Differences in Models

The Orienter is available in several different versions for which the current model numbers are given below:

Standard: without BFO: Model ADF-12D3
specify 14 volt, or 28 volt version
Beat Frequency Oscillator: Model ADF-12D4
specify 14 volt, or 28 volt version

A conversion kit (Lear Part No. 59352) is available for converting the standard model into the BFO version.

c. Equipment Required

(1) Single Installation. The equipment listed in Table 1-1 is required for the completion of a single Orienter installation.

TABLE 1-1. LEAR ORIENTER EQUIPMENT LIST

QUAN	ITEM	MODEL OR PART NUMBER
1	Tuner Unit	
	any one of the following:	
	Standard 14 volt	No. 702600-01
	Standard 28 volt	702600-02
	BFO 14 volt	702600-03
	BFO 28 volt	702600-04
1	Amplifier Unit	
	any one of the following:	
	Standard 14 volt	No. 702601-01
	Standard 28 volt	702601-02
	BFO 14 volt	702601-03
	BFO 28 volt	702601-04
1	Amplifier Shockmount	No. 96052
1	Loop Antenna	
	any one of the following:	
	Standard Loop for ADF-12 (96386-03 Autosyn)	Model 2320C
	Standard Speed Loop 701672 Autosyn	Model 2320A
	High Speed Loop, 701672 Autosyn	Model 2320B
1	Direction Indicator	
	any one of the following:	
	Standard	Model 2330A
	Rotatable Azimuth	No. 97401
	LEARMATIC	No. 1042
	(simultaneous display of gyro heading and radio heading)	
1	Connector and Switch Kit or Installation Kit	
	any one of the following kits:	
	Standard 14 volt	No. 701304-01
	Standard 28 volt	701304-02
	BFO 14 volt	701304-03
	BFO 28 volt	701304-04
	Installation Kits	
	Bonanza 35, A35, B35	No. 702960-01
	Navion	702960-02
	Stinson Voyager	702960-03
	Cessna 190, 195	702960-04
	Beech 18S	702960-05
	Widgeon	702960-06
	Bellanca	702960-07
	DeHavilland Beaver	702960-08
	Beech D-18S	702960-09
	Stagger Wing Beech	702960-10
	Bonanza 35, A35, B35 (Baggage compartment installations)	702960-11
	Bonanza C35, D35	702960-13
	Cessna 170, 180	702960-14
	Twin Bonanza	702960-16
	Aero Commander	702960-17
	Piper Apache	702960-18

SECTION II

THEORY OF OPERATION

1. General

a. Description

The Lear Orienter is a superhetrodyne receiver with special circuits to provide automatic indication of the source of received signals. The Function Switch on the front panel selects conventional receiver or automatic direction finder operation.

b. Communications Receiver Operation

Figure 2-1A is a simplified block diagram of the Orienter elements used when the equipment is operated as a communications receiver. The circuits used are conventional, comprising an r-f amplifier, an oscillator-converter, i-f amplifiers, a detector, and an audio amplifier.

c. ADF Operation

In adf operation (figure 2-1B), several stages are added to those shown in figure 2-1A. The first is a loop r-f amplifier that simply increases the amplitude of the loop signal. The loop signal is then fed to a modulator, the purpose of which is to introduce a 115 cps signal into the r-f. The phase of the 115 cps signal (which eventually determines the direction of loop rotation) is determined when the sense signal and modulated loop signal mix at the input of the common r-f amplifier.

The sequence of operation from common r-f amplifier onward is the same as in conventional operation with the exception of the compass output stages. Following the detector, a filter attenuates the audio modulation product present in the received

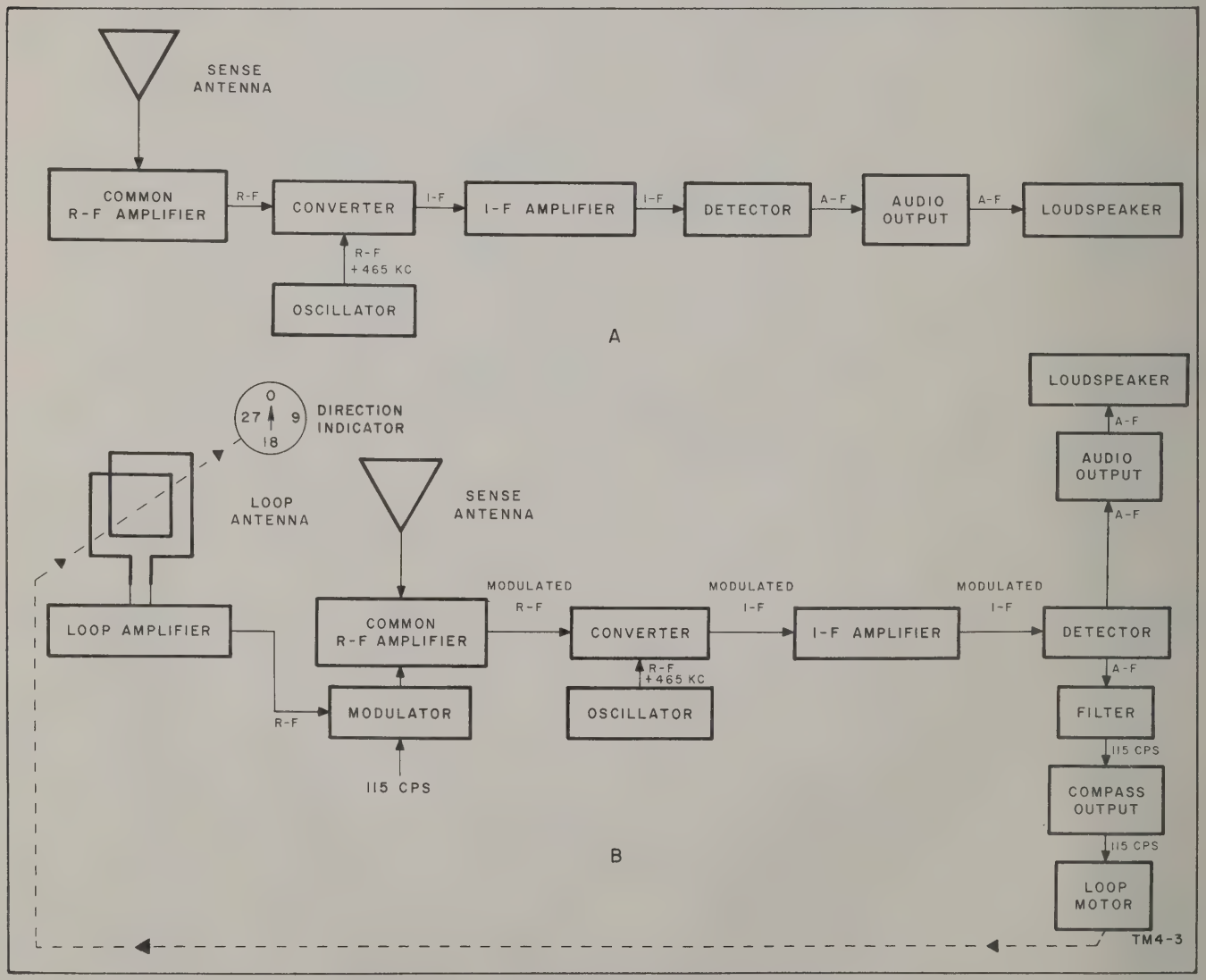


Figure 2-1. Orienter Simplified Block Diagram

signal and passes only the 115 cps signal to the compass motor signal amplifying stages.

2. Operation as an Automatic Direction Finder

a. General

When the Function Switch is in the ADF position, a condition is established in which the equipment circuits compare the phase of the signals received at the loop and sense antennas in such a way as to rotate the loop toward a null condition. Since the Direction Indicator is slaved to the loop, the positioning of the loop in the null condition results in a relative bearing being displayed by the indicator.

b. The Antennas

(1) The Loop Antenna. There are two antennas. One of them, the loop antenna, is directional; i.e. it is more sensitive to signals received from a direction toward the edge of the plane formed by its windings than it is to signals received from a direction perpendicular to that plane. This effect accounts for the ability of an operator to null a loop aurally, by listening for the zone of quiet. The directional characteristic of the loop antenna also accounts for the 180° directional ambiguity that results when an attempt is made to null a loop by the aural method. The conditions necessary to null the loop are met in two directions and, therefore, the operator has no way of telling whether he has a "true null" or an "artificial null."

In the Orienter, a second characteristic of loop antennas is utilized to eliminate 180° directional ambiguity. In the null condition, there is no appreciable output from a loop antenna. When the antenna is off-null, however, it has an output in which the phase is a function of the side of the loop closest to the transmitting station. As the loop crosses the null point from left of station to right of station, the output of the loop shifts 180° in phase. This effect is utilized in the circuits of the Orienter, to give a "left of true null, right of true null" sense to the system. Though it is theoretically possible for the loop to null at either side, in practice minute changes in apparent received signal direction cause the loop to pick up enough signal in "left" or "right" phase to return the element to the true null position.

(2) The Sense Antenna. The second antenna, called the "sense" antenna is non-directional. It is, therefore, equally sensitive to signals received from any direction. As will be demonstrated later, the variable phase output of the loop antenna is compared in the Orienter with the constant phase output of the sense antenna to cause the motor driven loop to seek a null condition.

(3) Derivation of Directional Information from the Antennas. The loop and sense antenna differ also in that the loop antenna picks up the electromagnetic component in the received signal, while the sense antenna picks up the electrostatic component. The result of this effect is that the output of the loop antenna is out of phase with that from the sense antenna by 90°. Whether the loop signal leads the sense signal by 90° or lags it by 90° is a function of which side of the loop is closest to the station; in other words, whether the loop is pointed to the left or to the right of the null point.

To recapitulate:

The loop antenna has no output in the null condition.

When the loop is off null, the signal delivered from the loop antenna is 90° out of phase with that delivered from the sense antenna.

When the loop is left of true null its output leads the sense output by 90°.

When the loop is right of true null its output lags the sense output by 90°.

It can thus be seen that all the information necessary to determine the direction of reception for a particular signal can be derived by comparing the varying loop antenna output against the unchanging sense antenna output.

The Orienter does precisely this when it is operated as an automatic direction finder.

c. The Comparison Circuits

(1) Purpose of the Phase Comparison Circuits. It has been demonstrated that all the information necessary for the determination of transmitting station direction is present in the form of phase differentials between the outputs of the loop and sense antennas. This phase information must, however, be translated into a visual bearing indication for the pilot. The process necessary to accomplish this translation begins in Modulator VT2 and the grid circuit of Common R-F Amplifier VT3.

In the Orienter, rotation of the loop antenna is achieved by delivering a reference signal of fixed phase, and a determination signal of varied phase to the windings of a two-phase induction type motor (see figure 2-3). The reference phase is fed directly from the power supply to one winding of the motor. The presence or absence of the varied phase determines whether or not the motor will rotate the loop. When present, the relationship of the varied phase to the reference phase determines the direction in which the motor rotates. The character of the varied phase is determined by the method described below.

(2) Operation of the Phase Comparison Circuits (Figure 2-2). It will be recalled (subpar. b above) that, in an off-null condition, the loop antenna has an output which is 90° out of phase with that delivered from the sense antenna. Whether the loop signal lags or leads the sense signal by 90° is a function of whether the loop is left or right of the true null point.

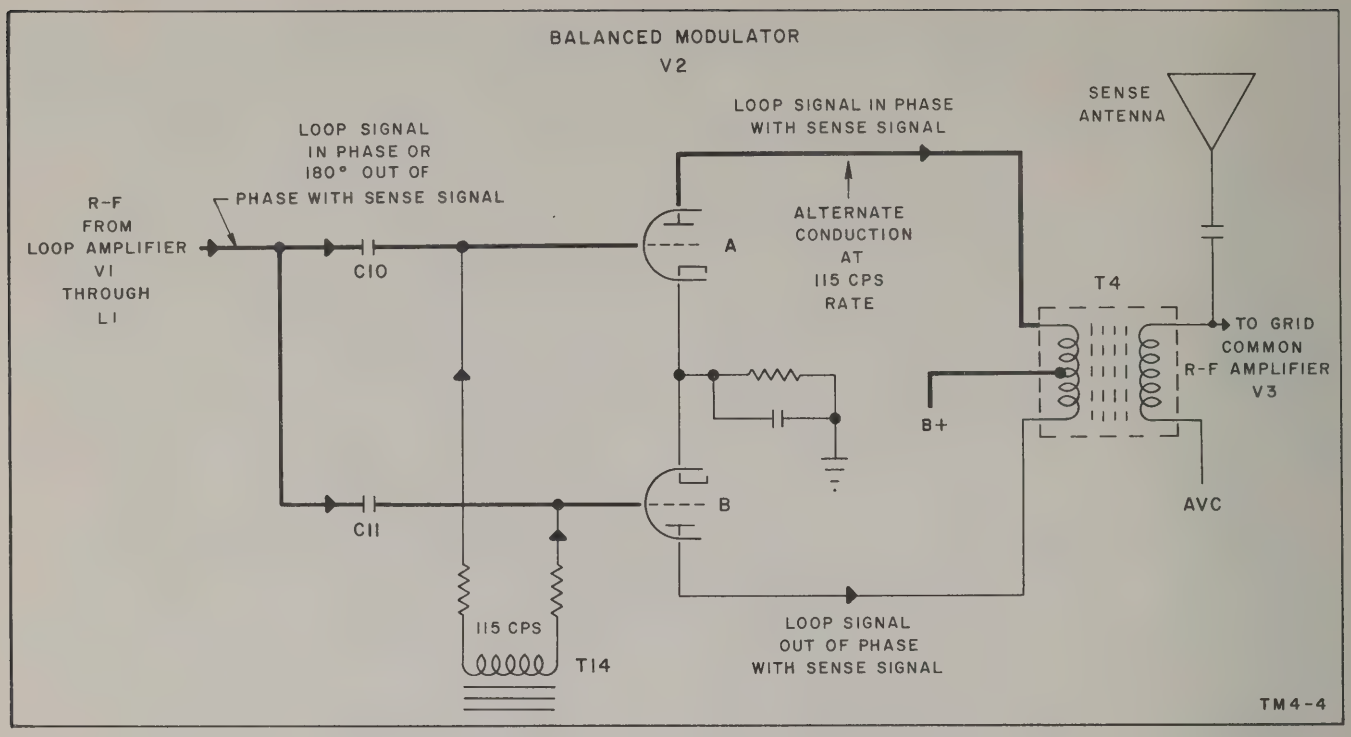


Figure 2-2. Phase Comparison Circuit, Simplified Diagram

In the loop r-f amplifier input circuit, this phase relationship is preserved. In the output of V1, however, a detuned network (L1), which appears as a capacitance to the loop signal, shifts the loop signal another 90°. This 90° shift is introduced as a delay in phase. The result: If the loop signal originally led the sense signal by 90°, it is in phase with the sense signal as the result of being delayed 90° in L1. If the loop signal originally lagged the sense signal 90°, it becomes 180° out of phase with the sense signal.

The output of L1 is then coupled through C10 and C11 to the grids of the two halves of Modulator V2.

In addition to the low level loop r-f signal, a high level audio signal is introduced at the grids of V2. This second signal is delivered from a 115 cps source in such a way that the grids of V2 are alternately cut-off on each half cycle of the applied signal. When the 115 cps signal applied at one V2 grid begins to go positive, that grid begins to conduct, while the other grid, receiving a negative half-cycle, is cut-off.

The result: The halves of V2 conduct the loop signal alternately at a 115 cps rate.

The plates of V2 are connected to B+ across opposite halves of the center-tapped primary of T4. Because of the center tap (and the phase lag introduced in L1) the signal conducted from one half of V2 will be in phase with the sense signal, while the signal conducted by the other half of V2 will be 180° out of phase with the sense signal.

The halves of V2 conduct alternately at a 115 cps rate. The sense signal is coupled to the secondary of T4. The sense signal will, therefore, alternately add with the output of one half of V2, and cancel the output of the other half.

Whether the sense signal adds with the output of V2A or V2B is a function of whether the loop is left or right of true null.

Thus it can be seen that the 115 cps signal enters common r-f amplifier V3 as a modulation envelope, the character of which is determined by the phase relationship of the sense and loop antenna signals.

d. System Operation (Refer to figure 2-3)

(1) General. It has been demonstrated that directional information is supplied to the Orienter through phase differentials that exist between signals fed from the sense and loop antennas. It has also been shown that, through a mixing process, the phase differentials of the sense and loop antenna signals are used to control the phase of a 115 cps modulation signal. These two effects are employed to position the loop antenna at true null in the manner described below.

(2) The Loop Motor. The loop motor is a two phase induction type. It has two windings and is phase sensitive. Assuming the proper power, the motor develops maximum torque when the a-c signal across one winding is 90° out of phase with the a-c across the other winding.

Another characteristic of a two-phase motor is that its direction of rotation depends upon the lag-lead relationship of the voltages applied at its windings.

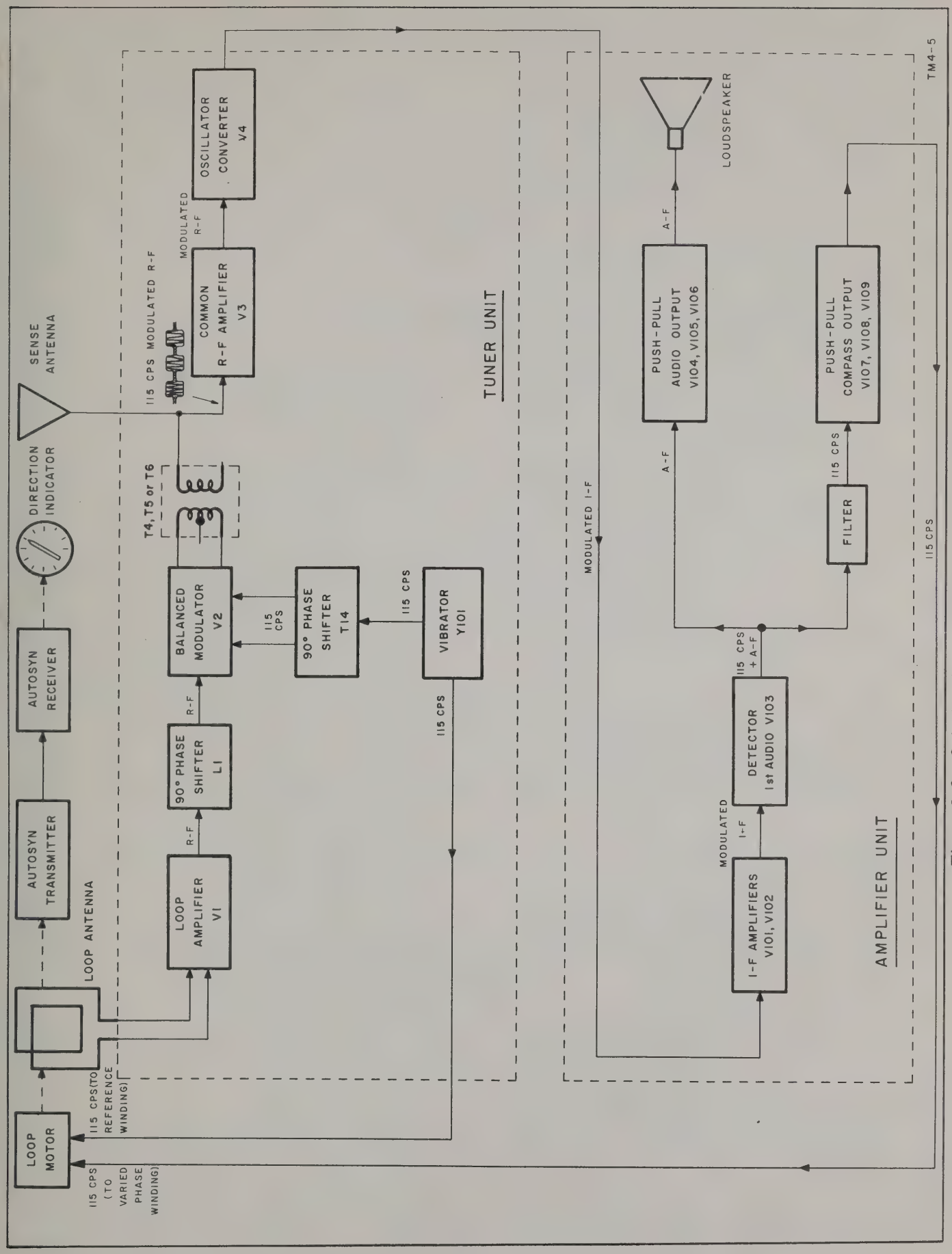


Figure 2-3. Orienter System Operation, Block Diagram

In the Orienter, a reference voltage of 115 cps is applied to one winding of the loop drive motor. The other winding is fed from the Compass Output stages. Referring to Figure 2-3, the 115 cps modulation which is introduced as a result of the action described in sub-paragraph c (2), above, is converted, amplified and detected just as any audio modulated signal would be. From the detector it is fed to a filter which eliminates undesirable modulation components present in the radio signal when initially received.

In the modulation-mixing process by which the sense and loop antennas determine the character of the 115 cps component which is eventually detected, only the lag-lead relationship of the modulated 115 cps to the reference voltage is established. T14, which connects the vibrator output to modulator V2, is an auto transformer which produces a phase shift of 90°. The phase relationship between the output from either side of T14 and the signal fed to the reference winding of the loop motor is then the relationship necessary to produce maximum output torque from the loop motor. In Figure 2-2, however, it was shown that the halves of V2 are connected so that the two halves (with reference to the 115 cps modulating voltage) are separated 180° in phase - one leading the reference phase by 90°, the other lagging the reference phase by 90°. By determining which of the V2 halves produces the wide portion of the modulation envelope and which half the narrow portion, the sense and loop antenna signals determine the side of T14 which will finally produce an output from the Compass Amplifier stages, and therefore, the direction in which the loop motor will rotate.

Rotation is, of course, always in the direction of true null. When true null is achieved, there is no output from the loop antenna, and therefore, no output from V2, since the 115 cps appearing at the plates of V2 cannot pass the r-f tuned interstage transformer connecting V2 with V3.

e. Summary of ADF Operation

Figure 2-4 shows the phase relationships that exist in the Orienter when the loop antenna is to the left or right of true null. Operation of the Orienter may be summarized by tracing steps 1 through 10 in the figure.

Under an off-null Condition:

(1) The output of the sense antenna is of constant phase.

(2) The output of the loop antenna is 90° out of phase with that of the sense antenna. Whether the Loop signal leads the sense signal by 90°, or lags it by 90°, depends upon whether the loop is right or left of true null.

(3) The loop signal is retarded an additional 90° in L1 after which it is either in phase, or out of phase with the sense signal.

(4) The loop signal is then fed to both halves of Balanced Modulator V2.

(5-6) A 115 cps switching voltage is fed to each triode half of V2. The triode halves alternately conduct and are cut-off, 180° out of phase.

(7-8) This action results in an r-f output from each half of the modulator in 115 cps "bursts". Note that the phase of each half's r-f output is a function of whether the loop is left or right of true null. This r-f is fed to the center-tapped primary of the interstage transformer connecting V2 with V3.

(9) The sense antenna signal is introduced at the secondary of the interstage transformer.

(10) If the loop is left of true null, the sense antenna signal cancels the output of the first half of V2 and adds with the output from the second half. If the loop is right of true null, an opposite adding-cancelling effect takes place.

(11) The mixing action of the sense and loop signals produces the modulation patterns shown in step 10. When the loop is right of true null, the 115 cps modulation envelope leads the fixed phase reference voltage (fed directly from the vibrator to one winding of the loop motor) by 90°. When the loop is left of true null the modulation envelope lags the reference voltage by 90°.

The loop drive motor is phase sensitive. It rotates when the voltage at one of its windings is 90° out of phase with the voltage at its other winding. The direction of its rotation depends upon whether the voltage fed from the compass output circuits leads, or lags the reference voltage by 90°.

(12) The phase relationships described in step 11, above, are preserved through converting, amplifying, and detecting stages in the Orienter to eventually provide a 115 cps voltage to the loop motor which causes the loop to rotate to a true null. When a null is reached, there is no output from the loop antenna, hence no signal is delivered to the varied phase winding of the loop motor.

(13) The autosyn transmitter connected to the loop transmits the directional information to the Direction Indicator in the cockpit.

3. Detailed Theory of Operation

Refer to the main schematic of the Orienter when reading this section (figure 3-14).

a. Loop Antenna Assembly

The loop antenna consists, physically, of two loops of wire grounded at a common point. The electrical effect is that of a single loop with a grounded center-tap. The purpose of the center-tap is to reduce electrostatic pick-up in the loop which, being in phase with the sense signal, would cause spurious directional indications. Both loops are wound on

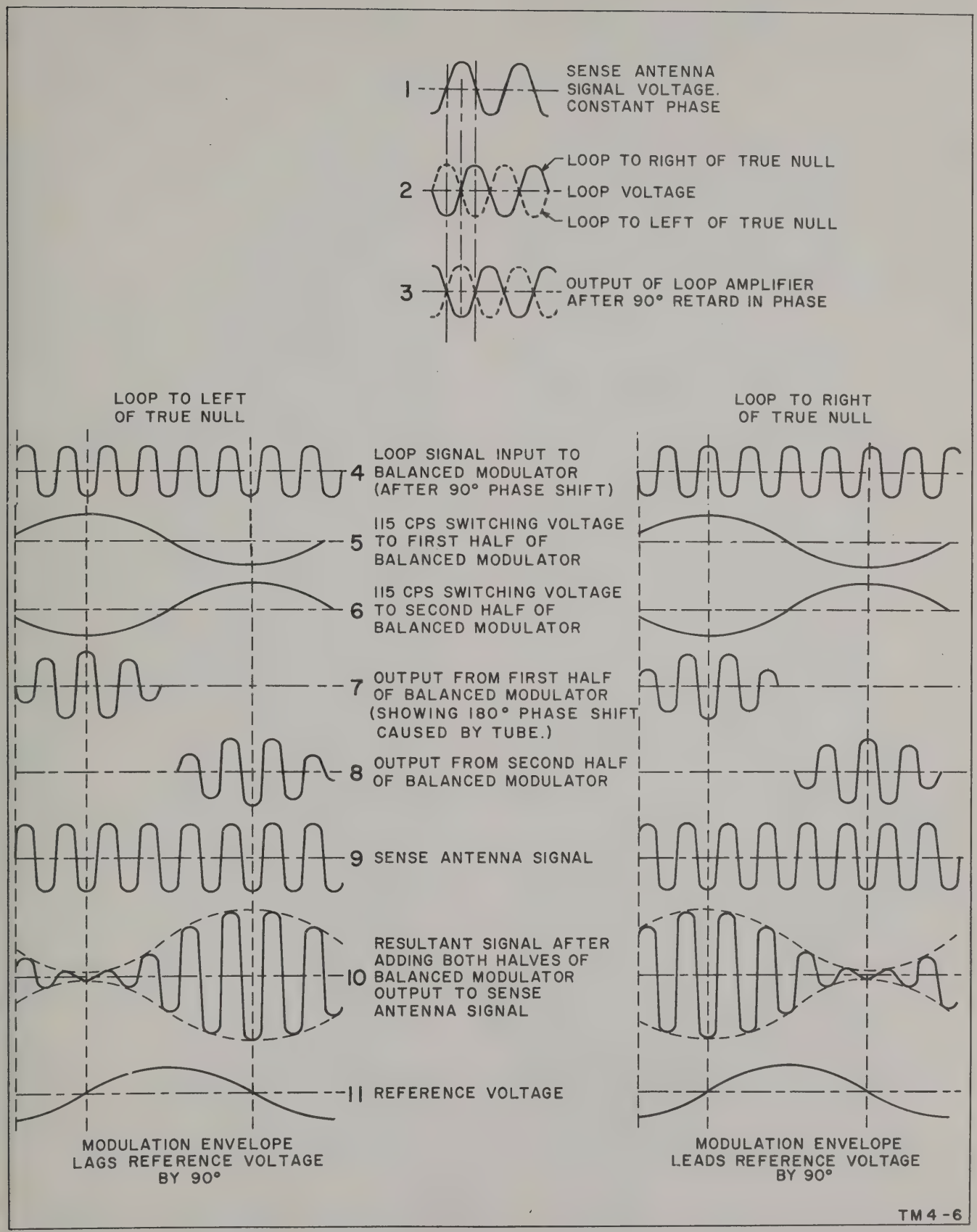

1
SENSE ANTENNA SIGNAL VOLTAGE. CONSTANT PHASE
2
LOOP TO RIGHT OF TRUE NULL
LOOP VOLTAGE
LOOP TO LEFT OF TRUE NULL
3
OUTPUT OF LOOP AMPLIFIER AFTER 90° RETARD IN PHASE
LOOP TO LEFT OF TRUE NULL
LOOP TO RIGHT OF TRUE NULL
4
LOOP SIGNAL INPUT TO BALANCED MODULATOR (AFTER 90° PHASE SHIFT)
5
115 CPS SWITCHING VOLTAGE TO FIRST HALF OF BALANCED MODULATOR
6
115 CPS SWITCHING VOLTAGE TO SECOND HALF OF BALANCED MODULATOR
7
OUTPUT FROM FIRST HALF OF BALANCED MODULATOR (SHOWING 180° PHASE SHIFT CAUSED BY TUBE.)
8
OUTPUT FROM SECOND HALF OF BALANCED MODULATOR
9
SENSE ANTENNA SIGNAL
10
RESULTANT SIGNAL AFTER ADDING BOTH HALVES OF BALANCED MODULATOR OUTPUT TO SENSE ANTENNA SIGNAL
11
REFERENCE VOLTAGE
MODULATION ENVELOPE LAGS REFERENCE VOLTAGE BY 90°
MODULATION ENVELOPE LEADS REFERENCE VOLTAGE BY 90°
TM4-6

Figure 2-4. Phase Relationships in Orienter ADF Operation

a common plastic support with a powdered iron core to increase the inductance. The ungrounded leads of the loop are connected through P1 of the Tuner Unit across the primary of T1, T2, or T3 depending upon which of these tuned transformers is selected by the operator with bandswitch section S1-B.

b. Tuner Unit

The Tuner Unit contains the Loop R-F Amplifier, the Balanced Modulator, the Common R-F Amplifier, the Oscillator, and Converter stages of the Orienter. Effectively, the Tuner Unit is the "head end" of the equipment which receives r-f signals and converts them to an i-f for further amplification and eventual detection.

(1) Loop R-F Amplifier. Any signal received at the loop antenna is coupled through T_1,T_2, or T_3 (depending upon which transformer is selected by bandswitch Sections S1A and S1B) and applied to the control grids of pentode amplifier V1. Fine tuning of the grid circuit of this conventional amplifier is provided by C7A, which is connected to the Tuning Control on the equipment front panel.

(2) Balanced Modulator. The balanced modulator (V2) supplies two 115 cps modulated loop antenna signals. With the Function Switch in the ADF position, the halves of the 12AU7 twin triode are operative with common cathode resistor R4 grounded. Each half alternately conducts the loop signal on the positive half-cycle and is cut-off on the negative half-cycle of the switching voltage delivered from the vibrator power supply through T14.

The plates of V2 feed opposite ends of the center-tapped transformer primary (T4, T5, or T6) selected by bandswitch sections S2A and S2B. B+ for both triode sections of V2 is connected through the transformer center tap. The signal in the transformer secondary is therefore induced alternately at a 115 cps rate by each half of the primary. Since the alternating r-f outputs of the triode halves of V2 are 180° out of phase, one of the halves of the transformer primary will produce an adding signal, with respect to the sense antenna signal, while the other half will produce a signal which cancels the sense antenna signal. The adding r-f envelope, modulated 115 cps, is applied to the grid of common r-f amplifier V3. This 115 cps is 90° out of phase with the 115 cps delivered directly from the vibrator power-supply to the reference winding of the loop motor. Whether the 115 cps modulation signal lags or leads the reference signal depends upon which half of the transformer primary adds with the sense signal and, thus, ultimately upon the relationship of the sense and loop signals.

When the Function Switch is in the REC position, the ground is removed from R4, and no signal is conducted by V2.

(3) Common R-F Amplifier. The modulation signal resulting from the adding-cancelling process described in (2) above, is amplified by V3 which is a conventional amplifier having tuned circuits in both grid and plate, selected by bandswitch sections S3A, S3B, and S4A. In ordinary receiver operation, V3 merely amplifies the sense signal.

AVC is applied to the grid of V3 from the AVC Detector section of V103 (in the Amplifier Unit).

(4) Oscillator-Converter. The signal delivered from V3 is converted to the equipment 465 KC i-f in V4, a 12BE6 pentagrid converter. This stage acts as both oscillator and mixer.

Pin 7 acts as the Mixer grid, Pin 1 the Oscillator grid, and the screen grid, Pin 6 acts as the oscillator plate. The cathode of V4 is common to both its functions. The oscillator is tuned by T10, T11, or T12 (selected by bandswitch S5A and S5B). C7A acts as a tuning vernier within the frequency range established by the main tank circuits.

The r-f voltage from V3 is coupled to the oscillator voltage by the common electron stream. The undesirable mixing products are eliminated in i-f transformer T13 which is coupled through a 72 ohm twisted pair to first i-f amplifier input transformer, T101.

(5) I-F Link. The i-f link provides a transfer of the i-f signal developed in the Tuner Unit to the i-f amplifiers located in the Amplifier Unit. Capacitor C38 in the Tuner Unit, together with C101 in the Amplifier Unit effect the required high impedance match. A low impedance cable may be connected between T13 and T101 since two parallel resonant circuits maintain the required high impedance at the output of the tuner and the input of the amplifier.

One circuit consists of the secondary of T13 and Capacitor C38, the second consists of C101 and the primary of T101. In this way, both V4 and V101 have a reflected high impedance and efficient transfer of the 465 KC signal is effected between them.

c. Amplifier Unit

The i-f amplifier, detector, avc detector, a-f voltage amplifier, audio and compass amplifiers, and the power supply are housed in the Amplifier Unit. The i-f amplifier, detector, and first a-f voltage amplifier are common to both adf and receiver functions of the equipment.

(1) I-F Amplifiers. I-F amplifiers V101 and V102 provide two stages of amplification common to adf and standard receiver operation. V101 and V102 are 6BJ6 remote cut-off pentodes. Avc voltage is fed to the grid of V101 through filter network R101 and C103. Coupling between stages is accomplished by interstage transformer T102.

(2) Detector, AVC, and First Audio Stage. Detection of the i-f signal and avc rectification are accomplished by the two diode sections of V103, a duo-diode triode 12AT6. The triode section of

the tube acts as a first audio amplifier. The detector diode section of the V103 receives the i-f signal through T103, develops the detected audio voltage across R110 and passes it, through C114, to the grid of the triode section of V103. The avc diode section receives the i-f signal through coupling capacitor C111 and develops the avc voltage across R108. The pulsating avc voltage is filtered by R107 and C107 and applied to common R-F Amplifier V3 and First i-f amplifier V101.

The audio signal developed by the triode section of V103 is delivered to both the audio and the compass amplifier stages of the equipment.

(3) Audio Amplifier. The audio amplifier provides final amplification for the audio component in the signal to which the Orienter is tuned. The circuit is conventional, including a second audio amplifier (V104A) a phase inverter (V104B), and final amplifier (V105, V106) connected push-pull. The output transformer has two secondary windings. One is a 3.2 ohm speaker winding, the other is a modulator winding for operation of an external transmitter.

(4) Compass Amplifier. In adf operation the compass amplifier stage provides one of the loop motor windings with a 115 cps signal. This signal is 90° out of phase with the signal at the other winding which is delivered directly from the vibrator power supply.

The signal from V103 is coupled through C132 to the divider and low-pass filter network which removes the higher frequency audio components (present due to the signal's original modulation at the transmitter) to prevent their actuating the loop motor.

The 115 cps component is then applied to amplifier-inverter V107 from which it is delivered to the loop motor winding through V108, V109 and T105, which form a conventional push-pull output amplifier. When the equipment is used as a conventional receiver, the cathode of V107 is removed from ground through function switch S6.

(5) Power Supply. The vibrator power supply provides all the d-c plate and screen voltages for the equipment, the 115 cps switching voltage supplied to the modulator stage, and the signal supplied the reference winding of the loop motor are also delivered from Y101.

T106 is the high voltage transformer for the two 6X5 rectifiers. The transformer has two secondary windings. One winding supplies the 115 cps reference and switching voltage, the other V110 and V111 which are connected in a full-wave circuit.

(6) Beat Frequency Oscillator (Model ADF-12 Only). A BFO in an automatic direction finder helps the pilot in two ways: (1) more exact tuning (thus more accurate operation) can be achieved and (2) unmodulated carriers and distant stations can be utilized for adf operation.

The BFO used in the Orienter utilizes the triode half of a 12AT6 (V201) connected in a Hartley Circuit tuned to 465 KC. The 12 volt plate supply is taken from the d-c filament sources. The oscillator is coupled to the detector section of V103 through a 10 uuf capacitor.

The steady 465 KC produced by the oscillator will zero beat with the converted carrier frequency only when the incoming signal is tuned to maximum strength. On either side of this zero beat position an audio signal representing the difference between the oscillator and the converted carrier frequency is produced.

The double pole single throw BFO switch is mounted externally. The arm of the switch is connected to ground. One pole of the switch (the "OFF" position) is connected in series with the Function switch. The other pole is connected to the cathode of V201. With the BFO switch in the OFF position, Function switch S6 connects the cathode circuits of modulator V2 and Compass Amplifier Inverter V107 to ground through the BFO switch. With the BFO switch ON, the equipment is automatically switched to REC operation for increased sensitivity without regard for the position of the Function switch. Returning the BFO switch to OFF places the equipment once more in ADF operation, assuming the Function switch to be in the ADF position.

SECTION III

MAINTENANCE PROCEDURES

1. Test and Maintenance Equipment Required

The following equipment is required for the proper testing and maintenance of the Orienter system:

TABLE 3-1. ORIENTER TEST AND MAINTENANCE EQUIPMENT

MANUFACTURER & PART NO. OR MODEL	NAME	DESCRIPTION & USE
Fabricate locally	Screen room	A recent ruling of the CAA requires that automatic direction finders be serviced at a CAA approved facility. Such a facility includes a screen room. The Lear publication TM-15 gives instructions for fabricating, calibrating, and obtaining approval for an inexpensive Lear ADF service facility. The publication is free. Order it by number through the LearCal Sales Department.
DuMont 304A or equivalent	Oscilloscope	Internal sweep, plus external X and Y axis input connectors. For checking modulation pattern and for use in alignment.
Hewlett-Packard 410B or equivalent	Vacuum Tube Voltmeter	For use in alignment and signal tracing procedures.
Opad-Green GPA 2810 or equivalent	Power Supply	Capable of 14 volts output at 6 amperes or 28 volts output at 3.5 amperes. Used as a power supply for bench testing the Orienter.
General Radio 583-A or equivalent	Output Meter	Capable of measuring 500 mw (1/2 watt) into 3.2 ohm load. For sensitivity checks and alignment procedures.
Hewlett-Packard 200CD or equivalent	Audio Oscillator	Capable of accurate 115 cps output. For checking vibrator frequency.
General Radio 805-0 or equivalent	Signal Generator	Capable of 200-1800 KC output modulated 30% with 400 cps. Calibrated microvolt attenuator. Used in sensitivity checks, signal tracing, and alignment procedures.
Lear No. 702564	Test Fitting	Fits the desiccant container tapped hole at bottom of loop antenna. For pressure testing the loop and for use in disassembly procedure.
Lear No. 63856	Tuner Extension Cable	Extension cable with dust cover specially drilled for alignment purposes. For making antenna matching adjustments in aircraft.
Lear No. 63884	Bench Test Cable Assembly	Connects equipment for bench test and alignment purposes.

2. Trouble Localization Chart

Table 3-2, The Orienter Trouble Localization Chart, gives trouble symptoms that can be observed when the equipment is installed for use in the aircraft. It also gives probable causes for the symptoms in order that trouble may be more-or-less localized before detailed tests begin.

The chart may be used in evaluating customer complaints and preventive maintenance checking, as well as forming a part of regular maintenance procedures.

For the conclusions as to trouble to be valid, all preceding checks in the chart must have been made without a trouble symptom being encountered.

TABLE 3-2. TROUBLE LOCALIZATION CHART

ITEM	ACTION OR CONDITION	EVIDENCE OF CORRECT OPERATION	FAILURE SYMPTOM	PROBABLE TROUBLE IF FAILURE IS EVIDENT	PROBABLE CORRECTIVE MEASURES
1. Pilot Lamp	Turn ON-OFF switch to ON.	Pilot Lamp Lights.	A. Pilot lamp does not light.	a. Pilot lamp burned out.	a. Check Pilot lamp.
				b. Primary power failure.	b. Check Aircraft power source. Check circuit breaker, main fuse.
				c. Orienter fuse burned out.	c. Check fuse and replace if necessary. If fuse burns out immediately upon replacement, check cabling then check Vibrator Y101, rectifiers V110, V111 for short.
				d. Open or shorted cabling.	d. Check between M of Amplifier P101 and power source for open or short. Check between 3 of tuner P1 and power source for open or short. Check wire between C of amplifier P101 and 10 of Tuner P1 for open or short. If Orienter is used in conjunction with VHF Xmitter, check modulator and Xmitter B+ (pins A & E of Amp. P101) for short or open.
2. Loudspeaker and Tuning Meter	Turn Function Switch to REC and tune in fairly strong station on each band.	Broadcast information is clear and understandable. Tuning Meter (if Orienter so equipped) deflects.	A. "Hash" only on all bands - Tuning Meter does not deflect (if not equipped with Tuning Meter suspect all troubles listed under symptoms A & B).	a. B+ open between Amplifier and Tuner.	a. Check wire between C of Amplifier P101 and 10 of Tuner P1 for open or short.
				b. Sense Antenna Connection bad.	b. Check sense antenna, feedthrough insulators, r-f cable and connections of antennas at Tuner input.
				c. Failure in V3 or S3A, B.	c. Check V3. Make continuity check of S3A and B.
			B. Complete silence or very faint "Hash" on all bands. Tuning Meter deflects O.K.	a. Failure in Audio output circuits.	a. Turn Function Switch to ADF, if Direction Indicator functions OK, Failure is in audio output circuits of Amplifier. Check V104, V105, V106.
				b. I-F link disconnected.	b. Check between 6 of Tuner P1 and V of Amplifier P101, 9 of Tuner P1 and X of Amp P101, for open or short.

TABLE 3-2. TROUBLE LOCALIZATION CHART (Cont)

ITEM	ACTION OR CONDITION	EVIDENCE OF CORRECT OPERATION	FAILURE SYMPTOM	PROBABLE TROUBLE IF FAILURE IS EVIDENT	PROBABLE CORRECTIVE MEASURES
2. Loud-speaker (cont'd)				c. Speaker Disconnected.	c. Connect speaker.
				d. Failure in oscillator converter i-f or detector stages.	d. Check in this order, V4, V101, V102, V103.
			C. Hash only on one band. Operation OK in other two bands.	a. Bandswitch failure.	a. Make continuity checks of S3A, S3B, S4B, S5A, and S5B on affected band.
				b. Interstage transformer.	b. Check T4, T5, T6 (V2-V3), T7, T8, T9 (V3-V4) and T10, T11, T12 (V4) for open or shorts. Check only transformers on effected band.
3. Direction Indicator	Turn Function Switch to ADF. Take check bearings on a medium power station in each Orienter band. Stations selected should be at least 50 mi. from check point.	Orienter takes correct bearings rapidly and positively with little hunting. 115 cps "buzz" is audible in Loudspeaker.	A. Direction Indicator does not turn, or turns aimlessly. 115 cps "buzz" is not audible in headset.	a. Loop lead-in open or shorted.	a. Check connections of loop twin co-ax at loop end and Tuner end.
				b. Function switch inoperative.	b. Check S6.
				c. Modulation signal not present.	c. Check between pin 1 of Tuner and pin H of amplifier for open or short. Check T14 for open or short. Make scope check given under par. 5g, this section.
				d. Failure in Loop Amplifier or Modulator circuit.	d. If Orienter operates properly on two bands, but not on third, check T1, T2, T3 or T4, T5, T6 on effected band. If failure is on all bands, check V1, V2, and associated circuits.
				e. Loop slip ring failure.	e. Check loop slip rings (see par. 7, this section).
			B. 115 cps "buzz" audible in loudspeaker, but Direction Indicator does not move or hunts aimlessly.	a. Sense Antenna grounded inadvertently.	a. Check sense antenna.
				b. Amplifier to loop connections open or shorted.	b. Check between pins B and H of Amplifier and pin A and E of Loop for short or open.
				c. Loop to Direction Indicator connections open or shorted.	c. Check loop to Direction Indicator cable.
				d. Failure in compass output circuits.	d. Check V107, V108, V109 and associated circuits.
				e. Failure in loop motor.	e. Check operation of loop motor.
				f. Failure in transmitting or receiving autosyn.	f. Check by substituting Loop and Azimuth Indicator known to be good.

3. Direction Indicator (Cont'd)			C. Orienter takes definite bearings 180° reversed.	a. Loop antenna lead-in connection reversed.	a. Reverse connections between 12 and 15 of Tuner P1.
			D. Orienter takes definite bearings, but each bearing wrong by a consistent amount (less than 180°).	a. Loop centerline not aligned with aircraft centerline.	a. For consistent error of ±3% or less, make use of the elongated holes in the loop base to shift the loop enough to compensate for the error.
				b. Autosyn transmitter improperly set.	b. See par. 6g, this section.
			E. Orienter takes correct bearings near 0° and 180°, but is erroneous in the Quadrant between 90° and 0°, 90° and 180°, as well as the quadrants each side of 270°.	a. Quadrantal Error.	a. Make quadrantal error adjustment as instructed in par. 6i, this section.
			F. Orienter hunts excessively on all bearings.	a. Bad installation.	a. Check installation according to par. 3a, this section.
				b. Weak tubes or poor alignment.	b. See paragraph 3 of this section.
4. Over the station performance.	Tune in a station then fly directly over it.	The Orienter indicates 0° as the station is approached. The Orienter hunts directly over the station. The Orienter indicates 180° after passing the station. "Zone of Confusion" should not exceed 1/2 mile.	A. Orienter indicates prematurely or too late that station has been passed. Zone of Confusion exceeds half mile circle.	a. Bad installation.	a. Check installation according to Orienter instructions in par. 3a of this section.

TABLE 3-3. ORIENTER INSTALLATION CHECKLIST

ITEM	WHAT TO LOOK FOR
1. Sense Antenna	Is sense antenna of the recommended type? (See Appendix I for typical installation illustrations.) Is the antenna properly located? Is the feed-through insulator of the proper type and in good condition? Are stand-off insulators in good condition?
2. Loop Antenna	Is the loop antenna mounted in the recommended position? (See Appendix I.) Is the antenna clear of long wire antennas that tend to build up field strength at the Orienter operating frequencies? Is the antenna clear of noise producing devices (generators, motors, etc.)? Is the antenna clear of closed loop devices (stays, landing gear, struts, etc.)? Is the antenna mounted so as to be protected against water damage? (Check bottom installations.) Check desiccator for "safe" moisture. Is the loop lead-in of the recommended length? (Exactly 27.5 feet for all aircraft excepting Aero Commander, Model ADF-1203S, 40 feet.) Are the loop cable connections properly made and electrically continuous? Is the loop base bonded to the aircraft primary structure? Has the Quadrantal Error coil tap been properly positioned? Is the loop housing free of paint?
3. Amplifier and Tuner Unit	Are the Amplifier and Tuner Units properly bonded to the airframe? Is the Tuner Unit mounted in its dust cover? Are the Cable Connections between the Tuner and the Amplifier properly made and electrically continuous? Is the front-end of the Tuner (V1 loop, V3, sense) aligned to match the impedance characteristics of the sense antenna and loop lead-in? (See paragraph 6h of this section.)

3. What to do in Case of "Marginal" Performance

In nearly every case the Trouble Shooting Chart will localize an Orienter failure to a point where simple voltage and resistance measurements will enable the technician to locate the specific component which has caused the failure.

In some cases, however, failure of an Orienter will be evidenced by marginal performance, i.e. the Orienter will take bearings, but slowly. There may be excessive hunting of the Direction Indicator, or the sensitivity or selectivity of the equipment may be down. In marginal cases, it is best to follow a set procedure for trouble shooting. The best procedure for the Orienter is as follows:

a. Check the Installation

A poor installation is almost always the cause of marginal adf performance. Table 3-3 is a checklist which will serve as a reminder when trouble shooting an Orienter Installation.

b. Check the Tubes

Aside from poor installation, the most probable cause of marginal Orienter operation will be tube operation. Always check the tubes in the Tuner and Amplifier Units before resorting to lengthy signal tracing or alignment procedures.

c. Signal Trace the Equipment

Trouble due to poor alignment of stages or marginal failure of components can be localized only by signal tracing techniques. Paragraph 5 of this section gives a suitable signal tracing procedure for the Orienter.

d. When to Align the Orienter

It will seldom be necessary to align the orienter. Failures due to other causes exceed failures due to mis-alignment by a ratio of about 20 to 1. This is a good ratio to keep in mind before electing to "peak-up" an equipment in order to improve performance. Generally, the stages most in need of alignment will be the input coupling transformers (T1, T2, and T3) to V1 and the interstage transformers (T4, T5 and T6) connecting V2 with V3. These should be peaked up when an Orienter is installed or re-installed. Their alignment can be easily checked with the Orienter in the aircraft, using the Tuner extension cable (see par. 6h).

The Oscillator tanks (T10, T11, and T12) may also require alignment when V4 is replaced.

Other stages of the Orienter will require re-alignment very rarely.

4. Voltage and Resistance Measurements

Typical voltage and resistance measurements are shown in figures 3-1 and 3-2. These measurements were taken from a random selected Orienter which had just passed Factory Quality Control inspection procedures, and therefore, met or exceeded all performance specifications. Because the readings were taken on one unit they should be regarded as being typical only. An Orienter can operate satisfactorily when individual readings vary from those shown as much as ±20%. However, an accrual within the allowable tolerances will usually cause marginal operation of the equipment.

Conditions under which the measurements were taken are shown in the figures.

5. Signal Tracing Procedures

CAUTION

Never operate the equipment with the loop motor cable disconnected unless a 125 ohm 2 watt resistor is placed in series with Pin H of P101.

a. General

At times certain obscure troubles occurring in the Orienter will require signal tracing procedures to be followed for their localization. Signal tracing can be defined as the injection of a signal of known amplitude and waveshape, and a comparison of the stage by stage resultant of that signal against data procured from an equipment known to be in good operating condition.

In the Orienter, signal tracing includes stage gain measurements where possible, and observations of modulation and other waveform data on the oscilloscope. When no definite suspicion as to a failure cause exists, the operations listed under sub-paragraphs b through g (below) must be followed in their listed order for trouble localization purposes.

NOTE

Allow 15 minutes warm-up for the equipment before performing each of these tests.

b. Audio Output Stage Gain Test

(1) Test Equipment Connection:

Audio Oscillator: Connect at pin 7 of V103 through .1 uf capacitor. 400 cps output.

Output Meter: Connect across 3.2 ohm loudspeaker voice coil. Connect 2 1K resistor in series with the voice coil to ground (see figure 3-6).

(2) ADF Set-Up:

Function Switch REC; Power Switch ON; Volume Control, fully clockwise; Sense Antenna disconnected; no other controls affect these measurements.

(3) Test Results: 5.5 volts maximum audio input to obtain 500 milliwatts output.

c. Compass Output Stage Gain Test:

(1) Test Equipment Connection:

Audio Oscillator: Connect as in b (1) above. 115 cps output.

Voltmeter: Connect between terminal 2 of T105 and ground (a-c measurement).

(2) ADF Set-Up:

Function Switch, ADF; Volume Control, fully clockwise; Power Switch, ON; Sense Antenna disconnected; Loop connected for normal operation; BFO off; no other controls affect these measurements.

(3) Test Results: 7.5 volts input to produce 12 volts output. This is an average figure. If more than 9 volts input is required to obtain the standard output voltage, V107, V108 and V109 should be checked.

d. I-F Stage Gain Test:

(1) Test Equipment Connection:

Signal Generator: Connect at pin 7 of V4 through .01 uf capacitor. 465 KC output modulated 30% with 400 cps.

Output Meter: Connected across 3.2 ohm loudspeaker voice coil. 1K resistor in series with the voice coil to ground.

(2) ADF Set-Up:

Function Switch, REC; Volume Control, fully clockwise; Power Switch, ON; Sense Antenna disconnected; set tuned to 300 KC.

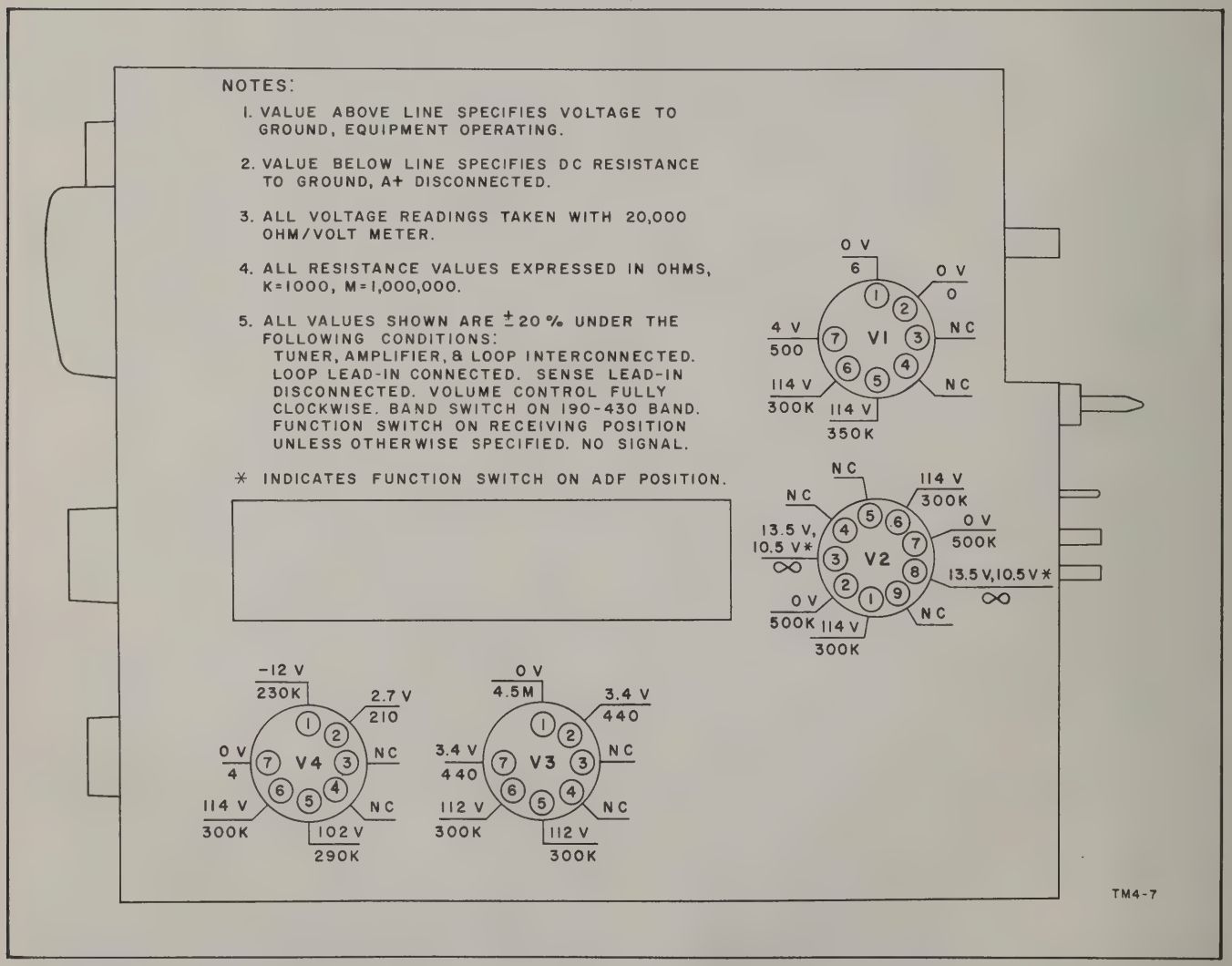

NOTES:
1. VALUE ABOVE LINE SPECIFIES VOLTAGE TO GROUND, EQUIPMENT OPERATING.
2. VALUE BELOW LINE SPECIFIES DC RESISTANCE TO GROUND, A+ DISCONNECTED.
3. ALL VOLTAGE READINGS TAKEN WITH 20,000 OHM/VOLT METER.
4. ALL RESISTANCE VALUES EXPRESSED IN OHMS, K=1000, M=1,000,000.
5. ALL VALUES SHOWN ARE ±20% UNDER THE FOLLOWING CONDITIONS: TUNER, AMPLIFIER, & LOOP INTERCONNECTED. LOOP LEAD-IN CONNECTED. SENSE LEAD-IN DISCONNECTED. VOLUME CONTROL FULLY CLOCKWISE. BAND SWITCH ON 190-430 BAND. FUNCTION SWITCH ON RECEIVING POSITION UNLESS OTHERWISE SPECIFIED. NO SIGNAL.
* INDICATES FUNCTION SWITCH ON ADF POSITION.
V1
V2
V3
V4
TM4-7

Figure 3-1. Typical Voltages and Resistances, Tuner Unit

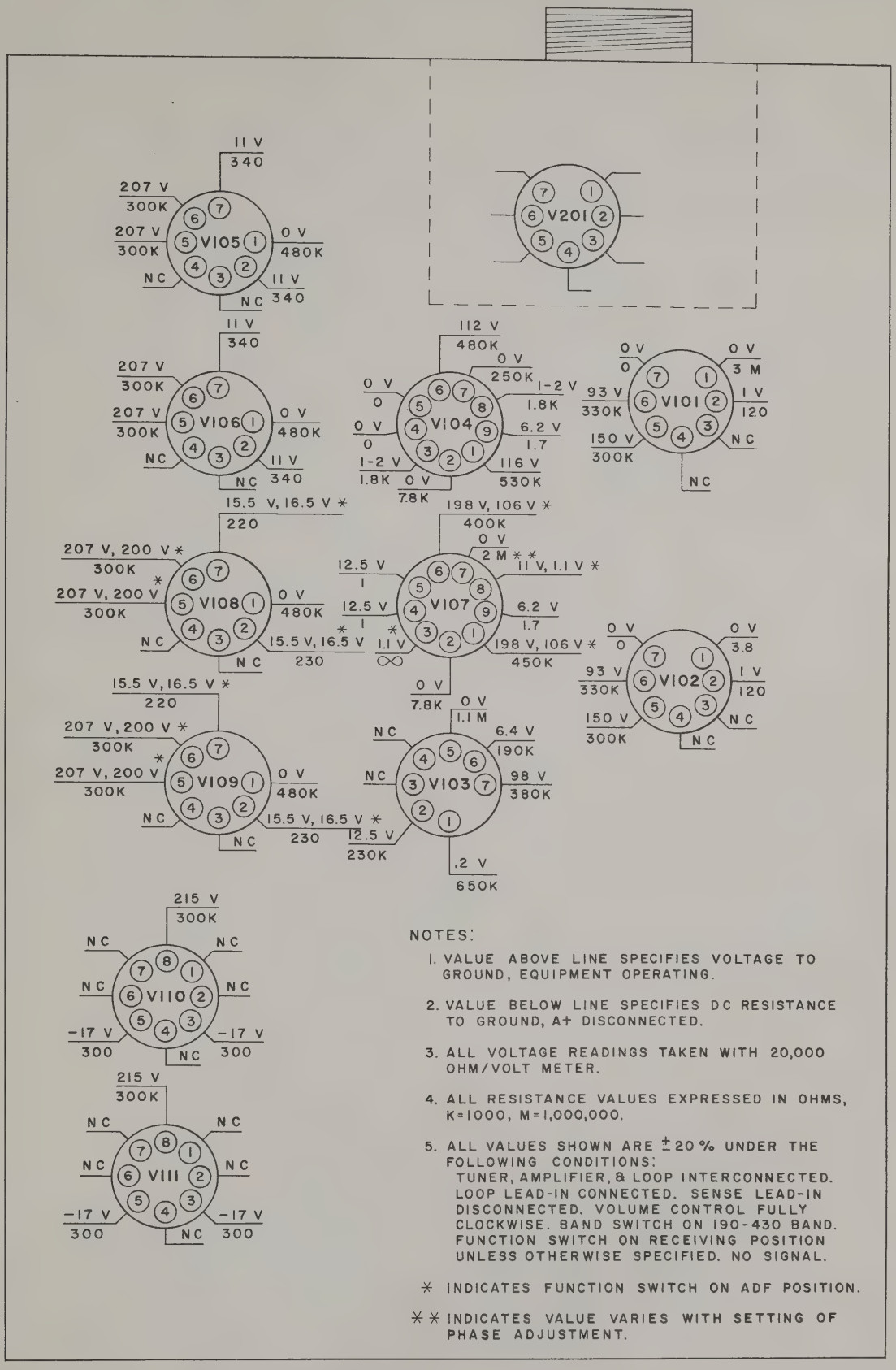

V201
V105
V106
V104
V101
V108
V107
V102
V109
V103
V110
V111
NOTES:
1. VALUE ABOVE LINE SPECIFIES VOLTAGE TO GROUND, EQUIPMENT OPERATING.
2. VALUE BELOW LINE SPECIFIES DC RESISTANCE TO GROUND, A+ DISCONNECTED.
3. ALL VOLTAGE READINGS TAKEN WITH 20,000 OHM/VOLT METER.
4. ALL RESISTANCE VALUES EXPRESSED IN OHMS, K=1000, M=1,000,000.
5. ALL VALUES SHOWN ARE ±20% UNDER THE FOLLOWING CONDITIONS: TUNER, AMPLIFIER, & LOOP INTERCONNECTED. LOOP LEAD-IN CONNECTED. SENSE LEAD-IN DISCONNECTED. VOLUME CONTROL FULLY CLOCKWISE. BAND SWITCH ON 190-430 BAND. FUNCTION SWITCH ON RECEIVING POSITION UNLESS OTHERWISE SPECIFIED. NO SIGNAL.
* INDICATES FUNCTION SWITCH ON ADF POSITION.
** INDICATES VALUE VARIES WITH SETTING OF PHASE ADJUSTMENT.
TM4-8

Figure 3-2. Typical Voltages and Resistances, Amplifier Unit

(3) Test Results: 100 - 400 uv input to obtain 500 mw output. More than 400 uv indicates that V4, V101, V102, V103 and associated circuitry should be checked.

e. R-F Stage Gain Test

(1) Test Equipment Connection:

Signal Generator: Connect at pin 1 of V3 through 50 uuf capacitor. 300 KC output modulated 30% with 400 cps.

Output Meter: Connect as in d (1), above.

Potentiometer: 1K, connected in series with the voice coil to ground (figure 3-6). Decrease resistance for tuning, increase resistance for measurements.

(2) ADF Set-Up:

Function Switch at REC; Volume Control fully clockwise; Power Switch ON; Sense Antenna disconnected; set tuned to 300 KC.

(3) Test Results:

10-15 microvolt input to produce 500 milliwatt output. Too little output indicates failure in the circuit of V3.

f. Loop and Modulator Test

(Signal levels in the Loop Amplifier and Balanced Modulator stages are too low to measure by ordinary means. The best method for checking these stages is, therefore, to use those stages already proven to provide the amplification necessary to obtain a stable modulation pattern for oscilloscope observation.)

(1) Test Equipment Connections: This test requires a screen room. Signal Generator and oscilloscope (only) connected as shown in figure 3-6C. Internal scope sync. Voltmeter need not be connected. Signal Generator unmodulated output frequencies as listed under "Test Results", below. Signal Generator output level high enough to produce 200 microvolts per meter at loop antenna.

(2) ADF Set-Up: Equipment connected as shown in figure 3-6C. Loop in position of maximum pick-up with loop motor reference voltage grounded through 125 ohm resistor as shown in the figure. Function Switch at ADF; Volume Control fully clockwise; Power Switch, ON; set tuned to Signal Generator output frequency.

(3) Test Results: Typical modulation patterns for various Signal Generator output frequencies are shown in figure 3-3. Set the Signal Generator to each of the frequencies indicated in the figure (210

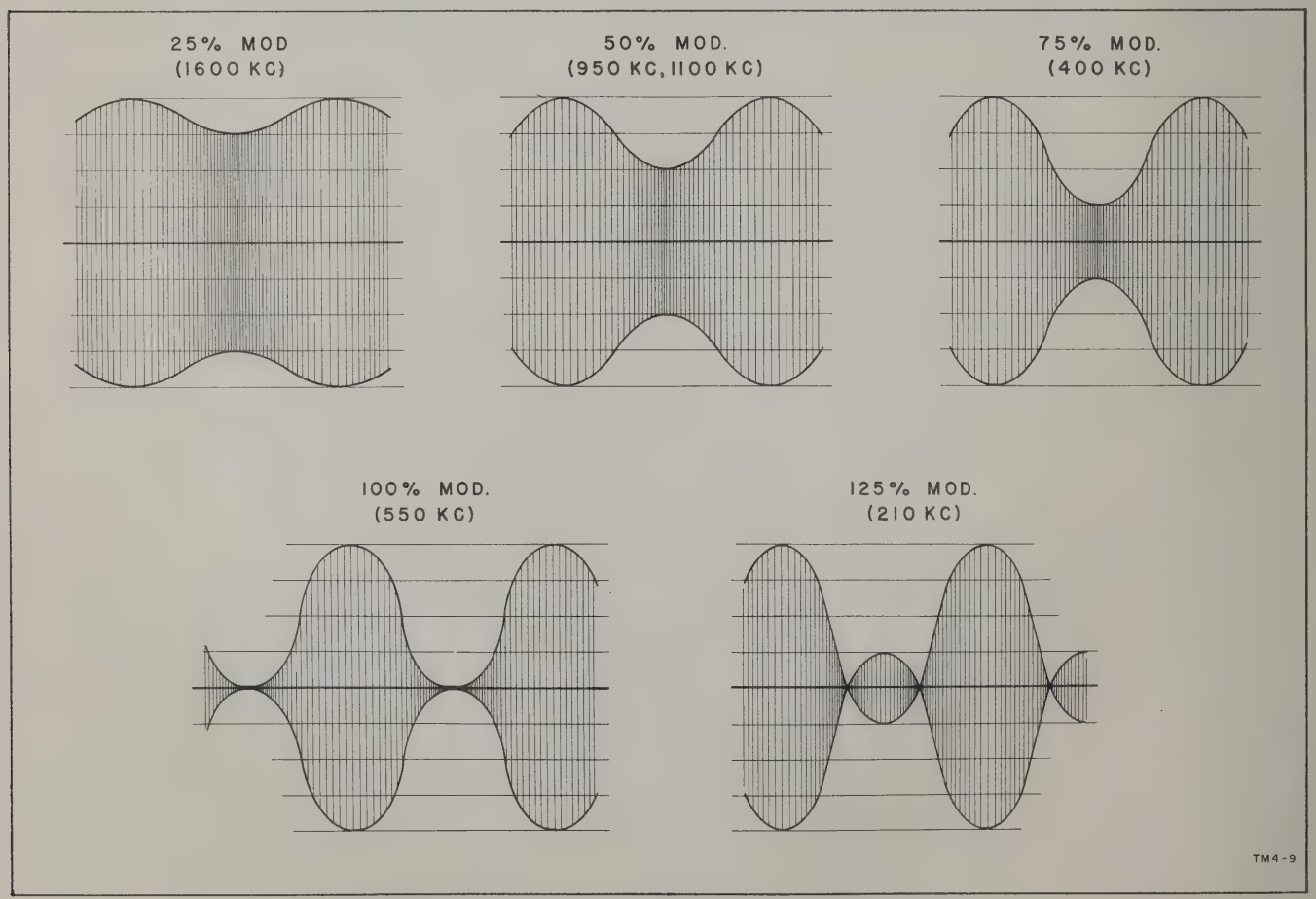


Figure 3-3. Typical Orienter Modulation Patterns

KC, 400 KC, 550 KC, 950 KC, 1100 KC, 1600 KC). Modulation patterns obtained at each frequency should approximate those shown in figure 3-3 when the Orienter is tuned exactly to the signal generator output frequency.

The most critical patterns are those at the high and the low ends of the equipment's frequency range. Less than 125% modulation at 210 KC indicates that satisfactory modulation will not be achieved at high end of range. Less than 15% modulation at high end of frequency range indicates that poor adf results will be obtained at high frequencies.

Satisfactory modulation patterns in two of the equipment's bands, unsatisfactory patterns in third band, indicates failure (transformer or bandswitch) in that band only.

Assuming correct equipment connections, lack of proper modulation patterns can be due to four factors occurring roughly in this order.

a) Poor alignment of LOOP and ANT stages.

b) Failure in V1 or V2. Check the tubes and make voltage and resistance measurements in these circuits. The modulation pattern should be checked in all bands to make certain that the interstage transformers and band switches are operating properly.

c) Failure in Loop Antenna. Check continuity through the slip rings and lead-in only. There is no need to disassemble the loop to make these checks as lack of modulation pattern does not mean motor or synchro failure (though failure of the loop to rotate, when modulation is present, does).

d) Failure of modulation signal to reach V2. This failure will be encountered most infrequently. It is due to either an open or short in L1, T14, or the connection between pin 1 of Tuner P1 and Pin H of Amplifier P101. The level of this a-c signal is difficult to measure, and the best way to check for its presence is with an oscilloscope. Connect the Y input at Pin 2 and then at Pin 4 of T14. Both connections of the Y input should produce a pattern similar to that shown in figure 3-5A.

g. Amplifier Phase Shift Test

(1) Test Equipment Connection: This test requires a screen room.

Signal Generator connected as shown in figure 3-6D. Output 300 KC unmodulated.

Oscilloscope "X" axis connected at Pin 1 of T14. "Y" axis connected at Pin 2 of T105.

(2) ADF Set-Up: Equipment connected as shown in figure 3-6D grounding loop motor reference voltage through 125 ohm resistor as shown in the figure.

Function Switch at ADF; Volume Control, fully clockwise; Power Switch, ON; Loop in position of maximum pickup; set tuned to Signal Generator output frequency.

(3) Test Results: The pattern on the oscilloscope must be as shown in figure 3-4. When the loop is hand rotated to a position of true null (parallel to radiating wire) the pattern must be as shown in figure 3-4C. The adjustment of R136 compensates for phase shift in the Amplifier (see alignment, par. 6f of this section).

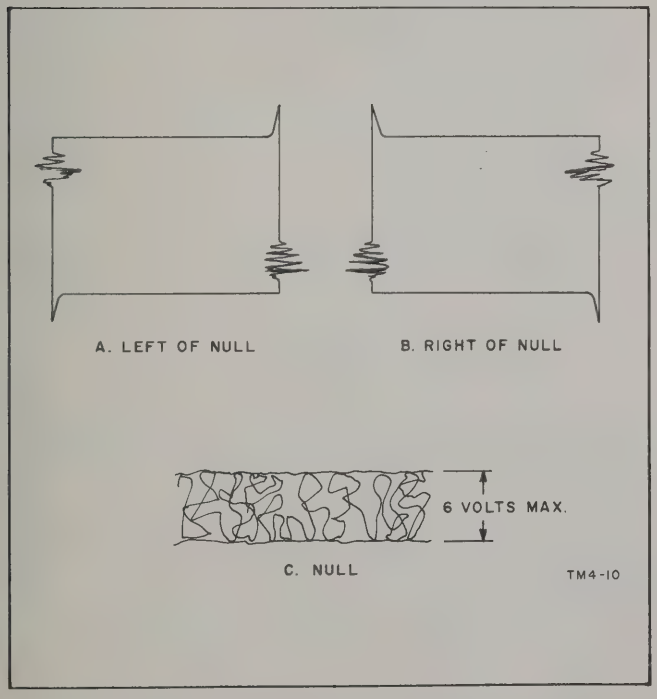


Figure 3-4. Phase Shift Pattern as Loop is Rotated Through Null

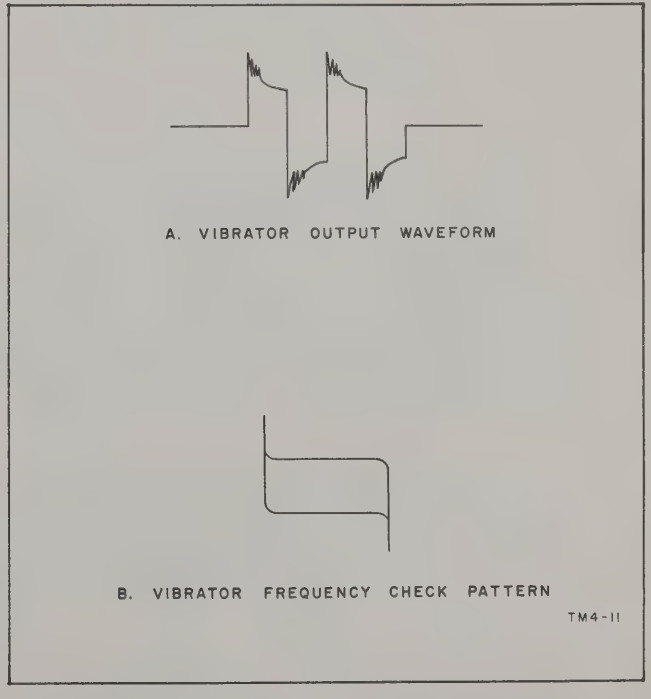


Figure 3-5. Vibrator Output Oscilloscope Patterns

h. Vibrator Operation Check

(1) Purpose: Vibrator Y101 not only provides high voltage for the operation of the equipment, but also supplies the a-c necessary to operate the loop motor and the Balanced Modulator circuit. Excessive hunting of the loop or marginal operation of the equipment can occasionally be caused by a vibrator operating at the wrong output frequency.

(2) Waveshape Check

a) Test Equipment Connection: Connect an oscilloscope at Pin 1 of T14. Internal sync.

b) Test Result: The vibrator waveform should resemble that shown in figure 3-5A. The transients should be no greater than 60% of the over-all amplitude, and the waveshape must be nearly rectangular.

(3) Frequency Check

a) Test Equipment Connection: Connect the "X" input of an oscilloscope to Pin 1 of T14. Connect the "Y" input of the output of an Audio Oscillator set to deliver 115 cps.

b) Test Result: Adjust the Audio Oscillator output to produce the pattern shown in figure 3-5B (1:1 Lissajous figure). The Vibrator output frequency must fall within the range of 106 to 122 cps.

(4) Conclusions. Failure of the vibrator to meet both its frequency and its output waveform specification indicates that the vibrator should be replaced or that one of the power supply filter capacitors is leaking through to ground.

6. Alignment Procedure

a. General

The full alignment of an automatic direction finder requires that a CAA approved test facility (screen room) be utilized. Other recommended test equipment is given in Table 3-1. Never undertake alignment of the Orienter unless tests indicate its necessity. Full alignment must follow the steps in the order listed in sub-paragraphs b, c, d, and e, below. Individual stages of the equipment may be aligned by following the procedures under the applicable individual headings.

b. Alignment Connections

Figure 3-6 shows the connections for alignment of the Orienter. The connections shown in Figure 3-6C and D must be made in a screen room.

c. Dial Calibration Adjustment

(1) Turn bandswitch to 480-1025 position.

(2) Turn Tuning Control to low end of band until tuning capacitor is completely meshed.

(3) Hairline in dial mask should align about 1/16" left of the last calibration mark (just preceding "550" on dial).

(4) To realign the dial, loosen the Allen-head setscrews fixing the dial to its shaft and rotate the celluloid on the shaft until the calibration mark (behind the mask at the top of the dial) lines up with the hairline when the capacitor plates are fully meshed.

d. I-F Alignment

(1) Equipment Set-Up: Connect equipment as illustrated in figure 3-6A. Set signal generator to deliver 465 KC modulated 30% with 400 cps. Input level just high enough to produce legible reading on the output meter. Orienter tuned to 300 KC; Power Switch ON; no other controls affect this operation.

(2) Instructions (see figure 3-7): Adjust in this order, 2nd i-f, 1st i-f, Input, and T13, to obtain peak reading on output meter. Adjust primaries first, secondaries second, for each transformer as stages are aligned. In order to prevent equipment avc invalidating adjustments, reduce output of Signal Generator after each peaking operation to point where output meter gives minimum legible reading.

e. Tuner Unit Alignment

(1) Equipment Set-Up: Connect equipment as shown in figure 3-6C. Screen room and special Tuner Dust Cover (drilled for alignment) necessary. If Tuning meter is available on equipment being tested, or in test panel, DC voltmeter shown in figure 3-6C is not necessary. Signal Generator Output frequencies as shown in figure 3-7, modulated 30% with 400 cps, Signal Generator output level kept at lowest possible level for legible readings on 2-3 volt scale of DC voltmeter.

(2) Instructions: Figure 3-7 shows the alignment points for this procedure, as well as the signal generator output frequency at which each band is aligned.

a) Alignment of Band 1

1. If DC voltmeter is used, tune each stage for minimum (dip) reading. If tuning meter is used, tune each stage for maximum (peak) reading.

2. With the Function Switch on REC, and the Orienter tuned to the Signal Generator Output Frequency, begin with low frequency (inductance) adjustments of Band 1. Adjust, in this order, "Osc," "R-F," "ANT," for dip (d-c voltmeter) or peak (tuning meter).

3. To prevent Orienter avc affecting meter readings, reduce the signal generator output after making each adjustment.

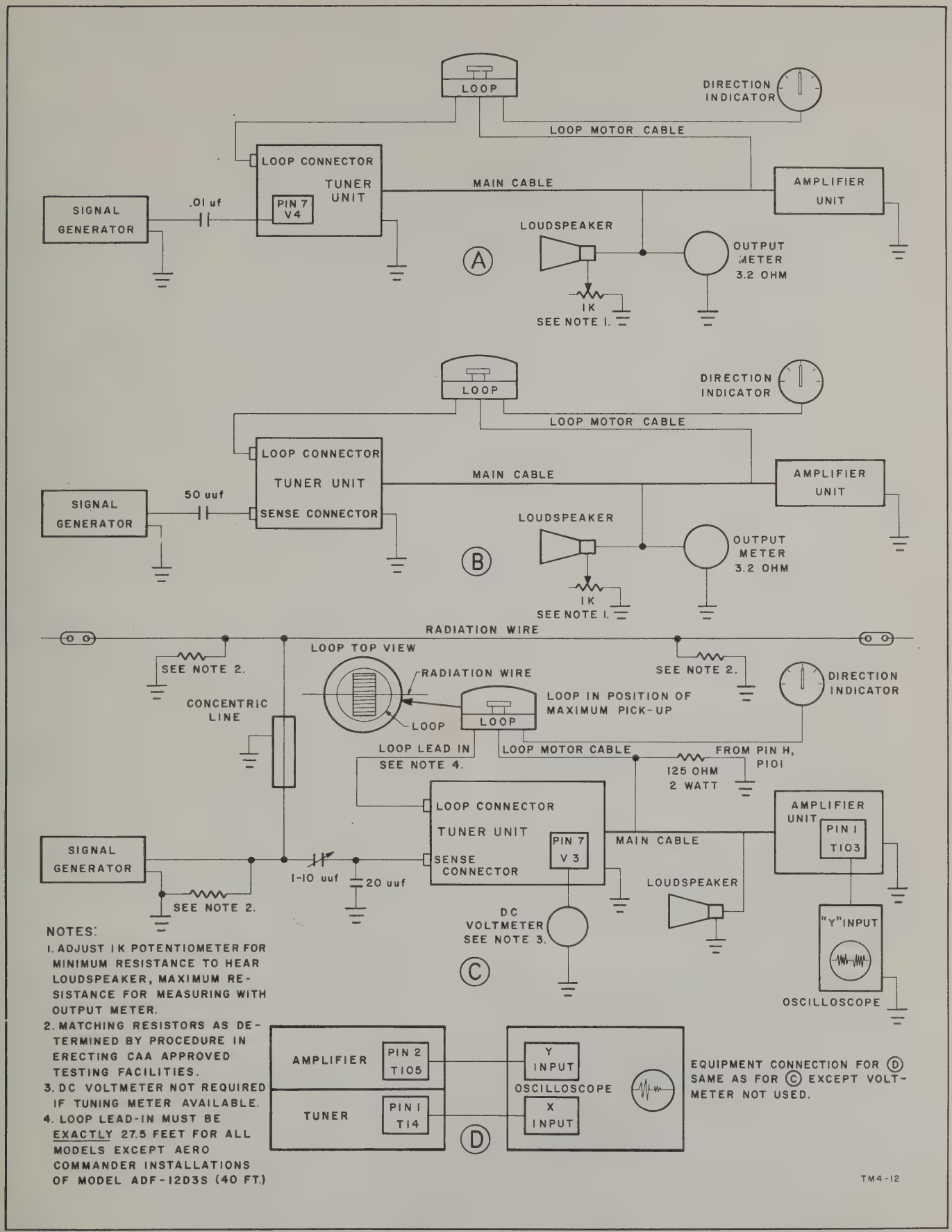


Figure 3-6. Orienter Alignment and Test Connections

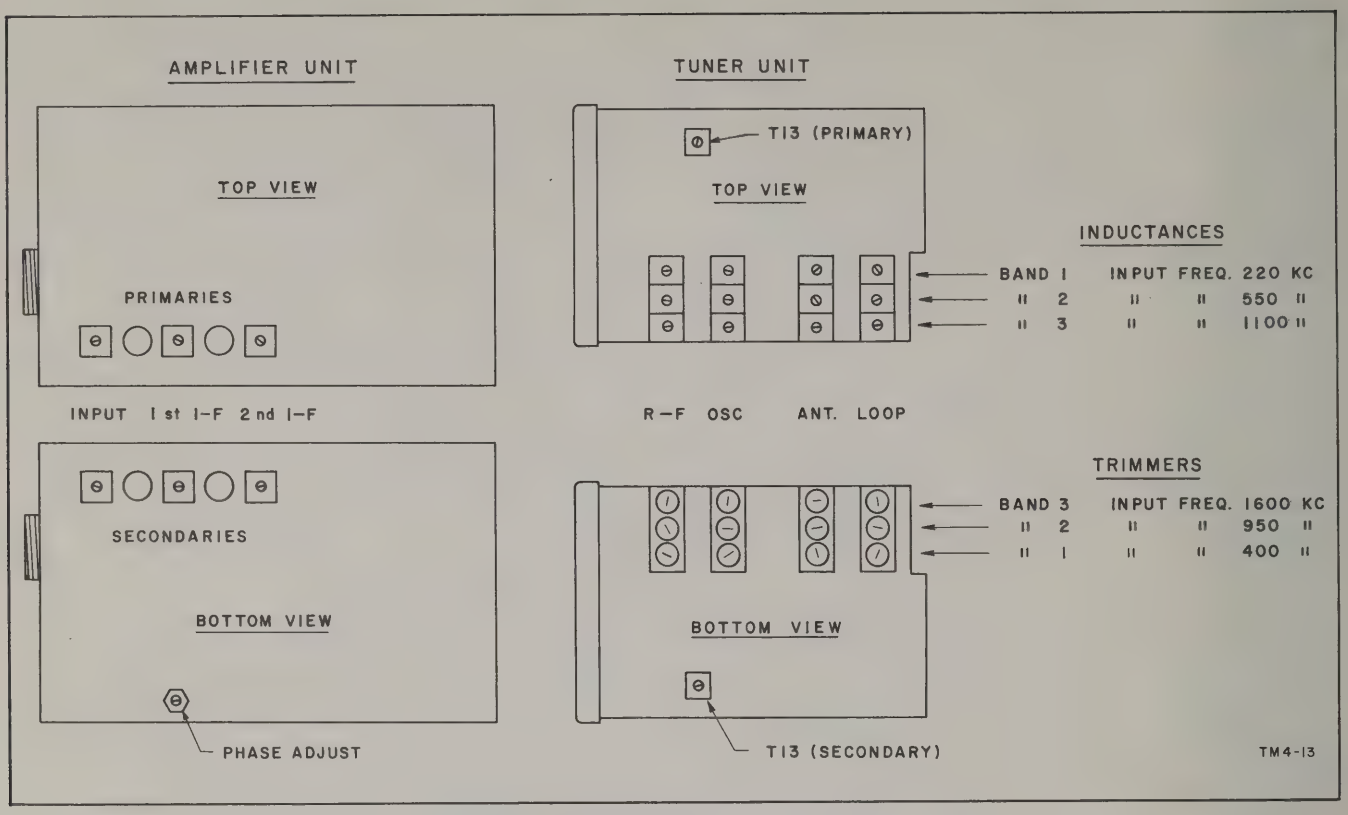


Figure 3-7. Orienter Alignment Points

4. To adjust the Loop Stage, turn off the Signal Generator modulation signal, and make the adjustment for a maximum modulation percentage (see figure 3-3).

5. Change the Signal Generator output to the high alignment frequency of Band 1, and adjust the trimmers for the same meter and oscilloscope indications used for the alignment of the low end of the band.

6. Repeat steps 2, 3, 4, and 5 for each Band 1 alignment frequency until no further improvement can be made in either the peaking procedure or in the percentage of modulation obtained. Always adjust the high frequency end of the band (trimmers) last. Never complete alignment of a band at its low end.

b) Alignment of Bands 2 and 3. Align bands 2 and 3 at the frequencies shown in figure 3-7, following the same sequence of inductance and trimmer adjustment used in the alignment of Band 1.

f. Amplifier Phase Shift Adjustment

(1) Equipment Set-Up: Connect the equipment as shown in figure 3-6D. Set the Signal Generator for 300 KC unmodulated output. Tune the Orienter to this signal in the ADF position. Set the loop in a position of maximum pick-up.

(2) Instructions: Adjust R-136 (figure 3-7) to obtain the pattern shown in figure 3-4A or 3-4B. Object is to get largest rectangle possible. Rotate loop through null position to check adjustment (see par. 5g, this section).

g. Autosyn Transmitter Adjustment

This adjustment is to be made only when symptom D of item 3 in the Trouble Localization Chart (Table 3-1) so indicates, and the error cannot be corrected by shifting the entire loop assembly utilizing the elongated mounting holes provided.

To align the Transmitting Autosyn so that the Direction Indicator tracks the motion of the loop core, proceed as follows:

(1) Model 2320A and B Loop Antennas Only

a) Remove the cover from the bottom of the autosyn transmitter. (The autosyn is the motor in the center of the loop assembly base.)

b) With the white dot on the loop core aligned with the arrow marked "FORWARD" on the loop base, adjust the autosyn transmitter for a zero (0°) reading on the Direction Indicator.

c) Replace the autosyn cover.

(2) Model 2320C and D Loop Antennas Only

a) Remove the plastic dome from the loop base, following the instructions in paragraph 7 of this section.

b) With power applied to the equipment, adjust the screw in the center of the loop core (top) to align the Direction Indicator needle with the white dot on the loop core.

c) Replace the dome, being careful to preserve the seal to the loop base as instructed in paragraph 7.

h. Antenna Matching Adjustments

This adjustment matches the Orienter input stages to the loop and sense antennas and their lead-ins. The adjustment is performed whenever an Orienter is installed for the first time in an aircraft, when an Orienter has been bench aligned and is re-installed, when the sense antenna is changed, or when marginal performance indicates that the input stages of the equipment may not be properly matched to the antennas. The adjustment requires the Tuner Unit to be removed from its permanent place of installation and the special extension cable (Lear part no. 63856) be inserted so that the adjustments may be made with the Tuner Dust Cover in place.

(1) 190-430 KC Matching Adjustment

a) Turn the Function switch to the REC position, and the band switch to the 190-430 position.

b) Tune in a fairly strong station as near 210 KC as possible. Do not touch the Tuning Control again during steps c, d, e, and f.

c) Referring to figure 3-7, adjust Band 1 Inductance "ANT" to give maximum volume in the loudspeaker or a maximum indication on the Tuning Meter (if available).

d) Disconnect the sense antenna.

e) Turn the Function switch to the ADF position.

f) Adjust Band 1 Inductance "LOOP" for a maximum 115 cps "buzz" in the loudspeaker.

g) Reconnect the sense antenna.

h) Turn the Function switch to the REC position and tune in a station between 370 and 410 KC. Do not touch the Tuning control during steps h, i, j, and k.

i) Adjust Band 1 trimmer "ANT" for maximum audio output.

j) Disconnect the sense antenna and turn the Function switch to the ADF position.

k) Adjust Band 1 Trimmer "LOOP" for maximum modulation sound in the loudspeaker.

l) Reconnect the sense antenna.

m) Repeat steps a through l until no further gain in audio output is achieved by adjusting either inductances or capacitances in the loop and the sense antenna input circuits.

(2) 480-1025 KC Matching Adjustment

a) Return the Function switch to the REC position.

b) Turn the Band switch to the 480-1025 position.

c) Tune in a station as near 550 KC as possible. Do not touch the tuning control during steps d, e, f, and g.

d) Adjust Band 2 Inductance "ANT" for a maximum audio output from the equipment.

e) Disconnect the sense antenna.

f) Turn the Function switch to the ADF position.

g) Adjust Band 2 Inductance "LOOP" for a maximum modulation sound in the loudspeaker.

h) Return the Function Switch to the REC position and reconnect the sense antenna.

i) Tune in a station as near 950 KC as possible. Do not touch the Tuning control during steps j, k. l, and m.

j) Adjust Band 2 Trimmer "ANT" for a maximum audio output from the equipment.

k) Disconnect the sense antenna, and place the Function switch in the ADF position.

l) Adjust Band 2 Trimmer "LOOP" for a maximum modulation sound in the loudspeaker.

m) Reconnect the sense antenna.

n) Repeat steps a-1 until no further gain in audio output is achieved by adjusting the inductances and capacitances in either the sense of loop circuits.

(3) 1025 KC - 1725 KC Matching Adjustment

a) Return the Function switch to the REC position.

b) Turn the Band switch to the 1026-1725 position.

c) Tune in a station as near 1100 KC as possible. After tuning, do not touch the Tuning control during steps e, f, g, and h.

d) Adjust Band 3 Inductance "ANT" for a maximum audio output from the equipment.

e) Disconnect the sense antenna.

f) Turn the Function switch to the ADF position.

g) Adjust Band 3 Inductance "LOOP" for a maximum modulation sound in the loudspeaker.

h) Return the Function switch to the REC position and reconnect the sense antenna.

i) Tune in a station as near 1700 KC as possible. Do not touch the Tuning control during steps j, k, l, and m.

j) Adjust Band 3 Trimmer "ANT" for a maximum audio output from the equipment.

k) Disconnect the sense antenna and turn the Function switch to the ADF position.

l) Adjust Band 3 Trimmer "LOOP" for a maximum audio output from the equipment.

m) Reconnect the sense antenna.

n) Repeat steps a through l until no further gain in audio output is achieved by adjusting the inductances or capacitances in either the sense or loop circuits.

o) Disconnect the extension cable and return the Tuner Unit to its place of permanent installation.

i. Quadrantal Error Correction

(1) General. This adjustment is to be made only when the Orienter is being installed for the first time or when the tests (Table 3-1) so indicate. In most aircraft installations of automatic direction finders, the metal in the fuselage, wings, etc. distorts the electromagnetic field of a received signal resulting in azimuth reading inaccuracies greatest between the four cardinal points with respect to the aircraft center line. This inaccuracy is known as quadrantal error, inasmuch as it is usually greatest near the center of each quadrant, going through zero at the cardinal points in a pattern similar to a sine wave. The Lear Orienter is equipped with an electrical correction system that largely eliminates this error when properly adjusted. On aircraft having a retractable landing gear with the loop antenna mounted on the bottom, this adjustment must be made in flight. On other types of aircraft, or in aircraft where the loop is mounted on the top of the plane, the adjustment may be made on the ground. To correct for quadrantal error, follow the instructions in sub-paragraph 2 or 3, below.

(2) Ground Quadrantal Error Corrective Procedures. To correct symptoms of quadrantal error in the Orienter proceed as follows:

a) The adjustment must be accomplished with the Lear Orienter installed for normal use in the aircraft. Site the aircraft at least 500 feet away from power lines, hangars, buried wires, or any other installation or natural feature that might cause radio waves to be refracted. For accurate results, elevate the tail of the aircraft to flight attitude. In tests performed on the ground, it is unnecessary to operate the engine or other electrical apparatus as in the case of a magnetic compass.

b) Turn the equipment on and tune in a fairly strong station about 50 miles from the testing point. If the equipment has a Tuning Meter, the station used for testing should give between one-third and two-thirds full deflection of the Tuning Meter at maximum received signal strength.

c) Rotate the aircraft until the Azimuth Indicator reads 0°.

d) Lay out an accurate line on the ground parallel to the fore-and-aft centerline of the aircraft.

e) Lay out a second line at an angle of 45° from the first in a counter-clockwise direction.

f) Turn the aircraft nose counter-clockwise, carefully aligning the plane's centerline with the 45° line and note the reading displayed on the Azimuth Indicator.

g) If No Quadrantal Error is present, the Azimuth Indicator will read 45°.

h) If Quadrantal Error is present, the Azimuth Indicator will read less than 45°. To correct the error, connect the ground lead (located near the corrector coil, Appendix drawing no. TM4-2) at the coil tap producing an indicator reading nearest 45°.

i) After locating the correct tap, solder the lead in place and replace loop fairing.

(3) Air Quadrantal Error Corrective Procedures. To make the quadrantal error correction for bottom loop installations on aircraft with retractable landing gear, it is necessary to perform the adjustment as the result of experimentation in the air since an extended landing gear assembly might effect the null characteristics of the loop. Because accurate magnetic courses must be flown, perform these tests in still air. To make the adjustment, proceed as follows:

a) Select a station at least 100 miles distant from the test point which produces a good strong loudspeaker signal or a one-third to two-thirds scale reading of the accessory Tuning Meter when tuned at maximum signal strength.

b) Fly directly toward the station as indicated by a 0° heading on the Azimuth Indicator. Carefully note the aircraft heading as indicated by the Magnetic or Gyro Compass. The magnetic heading of the aircraft must not change if this test is to be valid.

c) Fly the course established in b, above, for one minute, then decrease the magnetic or gyro compass heading 45°. The Azimuth Indicator should now read 45°.

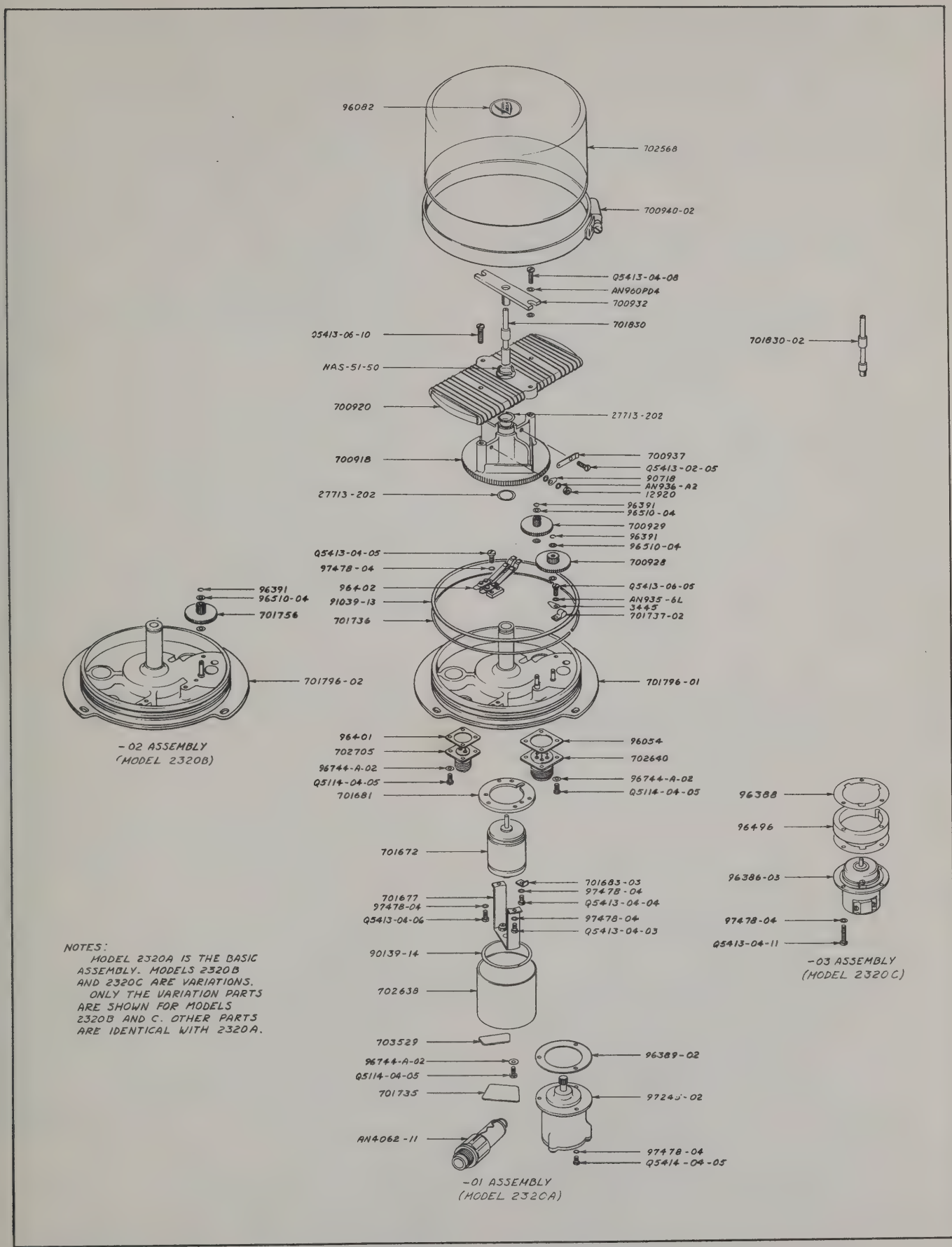


Figure 3-8. Model 2320 Loop Antenna, Exploded View

d) If the Azimuth Indicator reads less than 45°, quadrantal error is present.

d) If quadrantal error is present, carefully note the amount of error.

f) Upon returning to base, remove the fairing covering the loop assembly (DO NOT REMOVE THE PLASTIC DOME COVERING THE LOOP ITSELF).

g) Tap the corrector coil one tap up from the bottom for each 5° of error noted in flight (i.e. if 15° quadrantal error was noted, solder at the third tap). Solder the tap in place, and replace the fairing.

h) Repeat the procedure outlined in Steps a through g, and reposition the tap as necessary.

7. Disassembly and Reassembly of Model 2320 Loop Antenna

The Model 2320 Loop Antenna is hermetically sealed. This seal prevents inaccurate adf operation due to moisture effects. When, for any purpose, the loop is disassembled, the hermetic seal must be carefully preserved upon reassembly. NEVER drill holes in the plastic dome, or replace the dome without properly sealing and pressure testing the unit. Failure to follow these instructions will almost certainly result in poor operation of the equipment within a short time and can make it necessary for the customer to replace the entire loop assembly to return the adf to its original operating condition.

The clear plastic dome is provided for inspection purposes. It should be removed only when obvious damage to the loop gears or slip rings indicate their replacement is necessary, or when (Model 2320C only) tests indicate the autosyn transmitter required adjustment.

a. Remove the clear plastic dome from the loop base as follows:

(1) Loosen the screw clamp and remove it.

(2) Remove the desiccant container and install the test valve (Lear Part No. 702564) on the antenna base, using the hole normally employed to mount the desiccant container.

(3) Connect the valve to an air line and slowly increase air pressure until the dome is blown off.

CAUTION

The dome leaves the base with some force. BE CAREFUL. Do not place yourself in a position where you are likely to be struck by the dome as it disengages from the base. Do not perform this operation at a point where the dome may strike the concrete floor, a wall, or some other surface that may shatter it.

(4) The loop may be further disassembled by following ordinary mechanical procedures. Figure 3-8 gives the disassembly and reassembly order of parts.

b. Replace the plastic dome using the following procedure:

(1) Clean and Permatex from all surfaces with undiluted denatured alcohol.

(2) Apply Permatex to both the slip ring and gasket grooves.

(3) Put the gasket and slip ring in place while the Permatex is still wet.

(4) Apply a thin coat of Permatex all around the dome mounting flange of the antenna base assembly.

(5) Slip the dome into place while this second application of Permatex is still wet.

(6) Put the clamp in place immediately and secure it firmly, but not so tightly as to break the dome. (The retaining screw should be tightened by the application of 40 inch-pounds torque.)

(7) Pressure Testing. The loop assembly is built to withstand twelve pounds (internal) pressure. To test the unit after reassembly, proceed as follows:

a) Remove the desiccant container by undoing the knurled fitting.

b) Replace the container with the Lear No. 702564 test valve.

c) Pressurize the unit to 12 psi.

d) Submerge the unit in water and watch for bubbles.

e) Seal any places revealing leaks.

8. Final Testing

a. Bench Tests

The tests outlined below reveal the salient performance characteristics of the equipment and will indicate whether or not an Orienter is operating to its original specifications. The tests should be performed after the equipment has been repaired or as a regular part of preventive maintenance. To begin testing connect the Orienter to a source of A+ power (13.75 volts or 27.5 volts, with equipment operating).

(1) Test Power Consumption

a) Connect an ammeter at the A+ input to the Orienter. Orienter Function switch at both REC and ADF.

b) Current drawn at 13.75 volts shall not exceed 5.7 amperes. Current drawn at 27.5 volts shall not exceed 3.3 amperes.

(2) Test High Voltage

a) Connect a voltmeter at Pin 6 of V105.

b) Voltage shall be 200 vdc ±10 vdc.

c) Connect a voltmeter between the high end of R11 (between R11 and Pin 10 of P1) and ground.

d) Voltage shall be 125 vdc ±10 vdc.

(3) Test Loop Motor Reference Voltage

a) Connect a voltmeter between terminal 2 of L102 and ground. Orienter Function switch in the ADF position.

b) Voltage shall be not less than 9 vac and not more than 17 vac.

(4) Test I-F Sensitivity

a) Connect the equipment as shown in figure 3-6A. Set the signal generator for 465 KC output modulated 30% with 400 cps. Orienter Function switch in REC, and tuned to 300 KC.

b) Input level required to obtain 500 milliwatts output shall not be less than 100 microvolts nor more than 400 microvolts.

(5) Test I-F Selectivity

a) Allow the equipment to remain connected as in test 4. Input level, 200 microvolts.

b) Vary the Signal Generator 2.8 KC each side of 465 KC.

c) There shall be a maximum of -6 db attenuation of the audio output signal, as indicated on the output meter, 2.8 KC each side of the center frequency.

d) Vary the signal generator 25 KC each side of the center frequency.

e) There shall be a minimum of -60 db attenuation of the audio output 25 KC each side of the center frequency.

(6) Test Dial Calibration

a) Connect equipment as shown in Figure 3-6B, Signal Generator output 200 microvolts modulated 30% with 400 cps.

b) Set the Signal Generator at each of the following output frequencies and tune the Orienter to each output (REC operation) as indicated by a maximum reading on the output meter. Observe the Orienter dial setting at each tuned frequency. It shall read within the tolerances prescribed below.

Signal Generator Output Freq.	Dial Reading Tolerance
250 KC	±4 KC
350 KC	±4 KC
650 KC	±6 KC
850 KC	±6 KC
1250 KC	±15 KC
1440 KC	±15 KC

(7) Test RF Sensitivity and Signal-to-Noise Ratio (RFC operation)

a) Allow the equipment to remain connected as in test 6. Set the Signal Generator for 220 KC output modulated 30% with 400 cps. Tune the Orienter to this frequency.

b) The rated sensitivity of the ADF-12D3, D4 is 15 microvolts to procude 500 mw. The rated signal-noise ratio is -6 db $\frac{\text{signal + noise}}{\text{noise}}$. To check these ratings for the first test frequency follow the procedure described in c, d, and e, below.

c) Run the signal generator output level up to the point where the output meter reads 500 milliwatts. The Signal Generator output shall be 15 microvolts or less. This checks the sensitivity.

d) Turn off the signal generator modulation only. The output meter shall drop 6 db or more. This checks the signal-noise ratio.

e) Repeat the procedure (3 and 4) for the following Signal Generator Output frequencies: 400 KC, 550 KC, 950 KC, 1100 KC, 1600 KC. The Orienter Sensitivity and $\frac{\text{signal + noise}}{\text{noise}}$ ratio shall meet the ratings of sub-paragraph (b) for each frequency.

(8) Test Audio Output Distortion

a) Allow the equipment to remain connected as in test 7. Set the Signal Generator to deliver 300 KC output modulated 30% with 400 cps.

b) Connect an Oscilloscope at the loudspeaker. "Y" input at the hot lead of the voice coil, Internal Sync.

c) Gradually increase the output level of the signal generator, observing the modulation component as it appears on the oscilloscope, and output meter.

d) The sine wave on the oscilloscope shall not distort (square off at the peaks) until the output level has reached or exceeded 1.2 watts. (Note: Output distortion is usually caused by limiting in an amplifier. If distortion is encountered, check all tubes in the equipment beginning with those in the audio amplifier.)

(9) Test Automatic Volume Control

a) Disconnect the Oscilloscope. Turn the Function switch to ADF. Otherwise, allow the test equipment to remain connected as in Test 8, above. Set the signal generator for 300 KC modulated 30% with 400 cps at the level necessary to produce 10 milliwatts output from the Orienter.

b) Increase signal generator output to 100,000 microvolts.

c) The Orienter output shall not increase more than 18 db as indicated on the output meter.

(10) Test Automatic Direction Finding Sensitivity and Loop Rotational Speed

a) A screen room is required for this test. The equipment is connected as shown in figure 3-6C, with the exception that the oscilloscope and DC voltmeter need not be connected, and the loop motor cable is connected for normal operation. The 125 ohm 2 watt resistor is not used.

b) This test requires that the microvolts per meter field strength at the loop antenna be known. (Signal Generator output level divided by Screen Room attenuator factor.) This information is derived when the CAA approved test facility is constructed. Instructions for constructing and calibrating such a facility are given in the Lear Manual TM-15, or, if your screen room has been built by a professional, it will have been already calibrated.

c) Set the Signal Generator Output Level to derive 25 microvolts per meter at the loop.

d) Set the Signal Generator output frequency at the following values. The loop shall rotate 180° in 6 seconds at each frequency, and take bearings accurate to ±3°. Make certain the Orienter is tuned exactly to each signal generator output frequency. 220 KC, 400 KC, 550 KC, 950 KC, 1100 KC, 1600 KC.

(11) Test No Signal Loop Rotation

a) Connect the equipment as test 10, above.

b) With Function switch in ADF position and no signal output from Signal Generator, loop shall not rotate faster than 12° per second.

b. Preflight and Flight Tests

After repair or bench test, an Orienter installed in an aircraft must be realigned before flight as instructed in paragraph 6h of this section.

(1) Preflight Tests

a) Test Identification Function (REC). Select three stations for each band. The stations should be selected with one as near the center, and the high and low ends, of each band as possible.

b) With the Function switch in the REC position, tune the equipment to each of the stations selected.

c) The signals received shall be clearly intelligible. The volume control shall function properly.

d) (BFO models only.) Turn the BFO switch on and check a station in each frequency band to insure that it may be properly zero beat with the Tuning control.

e) Automatic Direction Finding Function (ADF). Position the aircraft on a known true heading. Take a bearing on three stations, at the high, low, and middle of each frequency band. Compare the Orienter bearings with the facts as ascertained from a map. The bearings must be accurate (±4°) with little or no hunting on strong stations.

NOTE

Bearing accuracy may be affected by buildings, wires, lights, transmitting radio equipment, or projecting natural features near the test site.

(2) Flight Tests

a) To properly determine the in-flight bearing accuracy of this equipment, a point should be established on the ground from which three (one in each equipment band) stations at a distance of at least 50 miles, and of normal power, may be referenced.

b) Fly over the point chosen, on a known heading, and take bearings on the three stations selected. Bearing accuracy shall be ±7° and there shall be no excessive hunting of the Direction Indicator.

c) Over-The-Station Performance Check. Select a low frequency range station and home on it from a point about 50 miles distant. Fly a 0° radio course. As the aircraft approaches, then crosses the cone of silence, the Direction Indicator shall fluctuate a maximum of ±15° either side of 0°, then abruptly swing to a reading of 180°. In no case shall the area of confusion extend beyond the cone of silence.

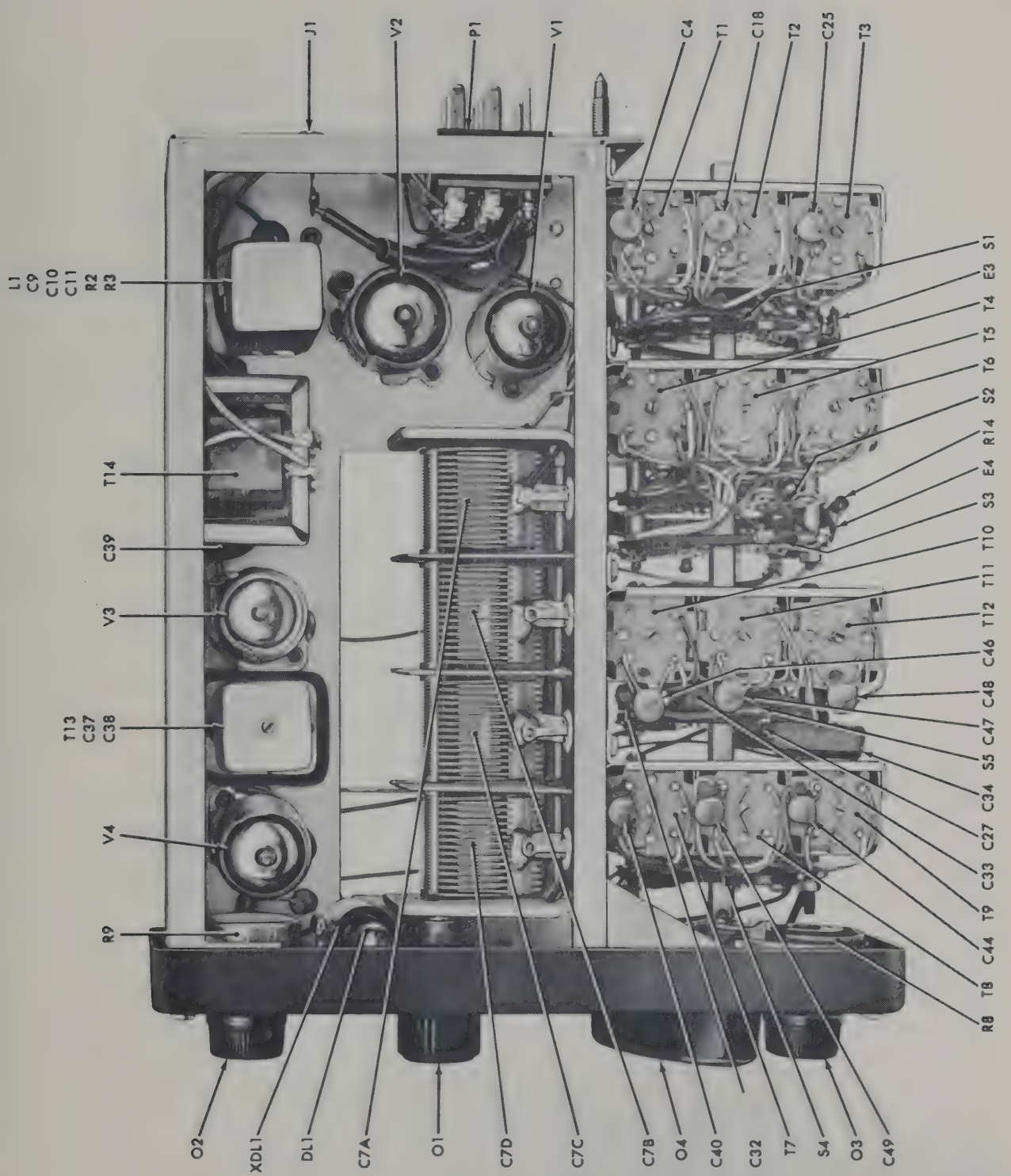


Figure 3-9. No. 702600 Tuner Unit, Top View

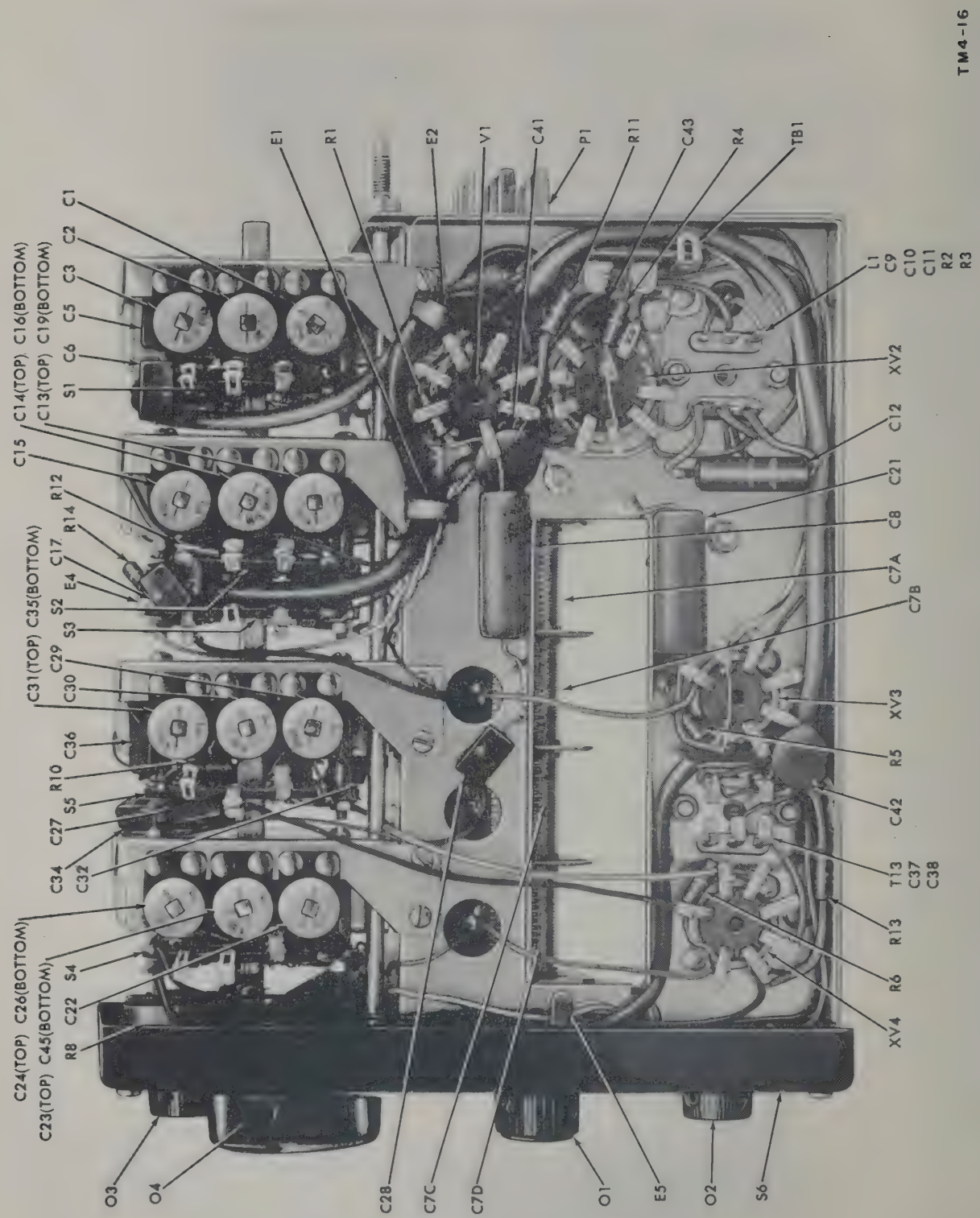

C24(TOP) C26(BOTTOM)
C23(TOP) C45(BOTTOM)
R8 C22 S4
C34 C27 R10 S5 C36
C32
C31(TOP) C35(BOTTOM)
C30 C29 S3 S2 E4 C17 R14 R12
C15 C14(TOP) C16(BOTTOM)
C13(TOP) C19(BOTTOM)
S1 C6 C5 C3 C2 C1
E1 R1 E2 V1 C41 P1 R11 C43 R4 TB1
L1 C9 C10 C11 R2 R3
XV2 C12 C21 C8 C7A C7B
XV3 R5 C42 T13 C37 C38 R13 R6 XV4
O3 O4 C28 C7C C7D O1 E5 O2 S6
TM4-16

Figure 3-10. No. 702600 Tuner Unit, Bottom View

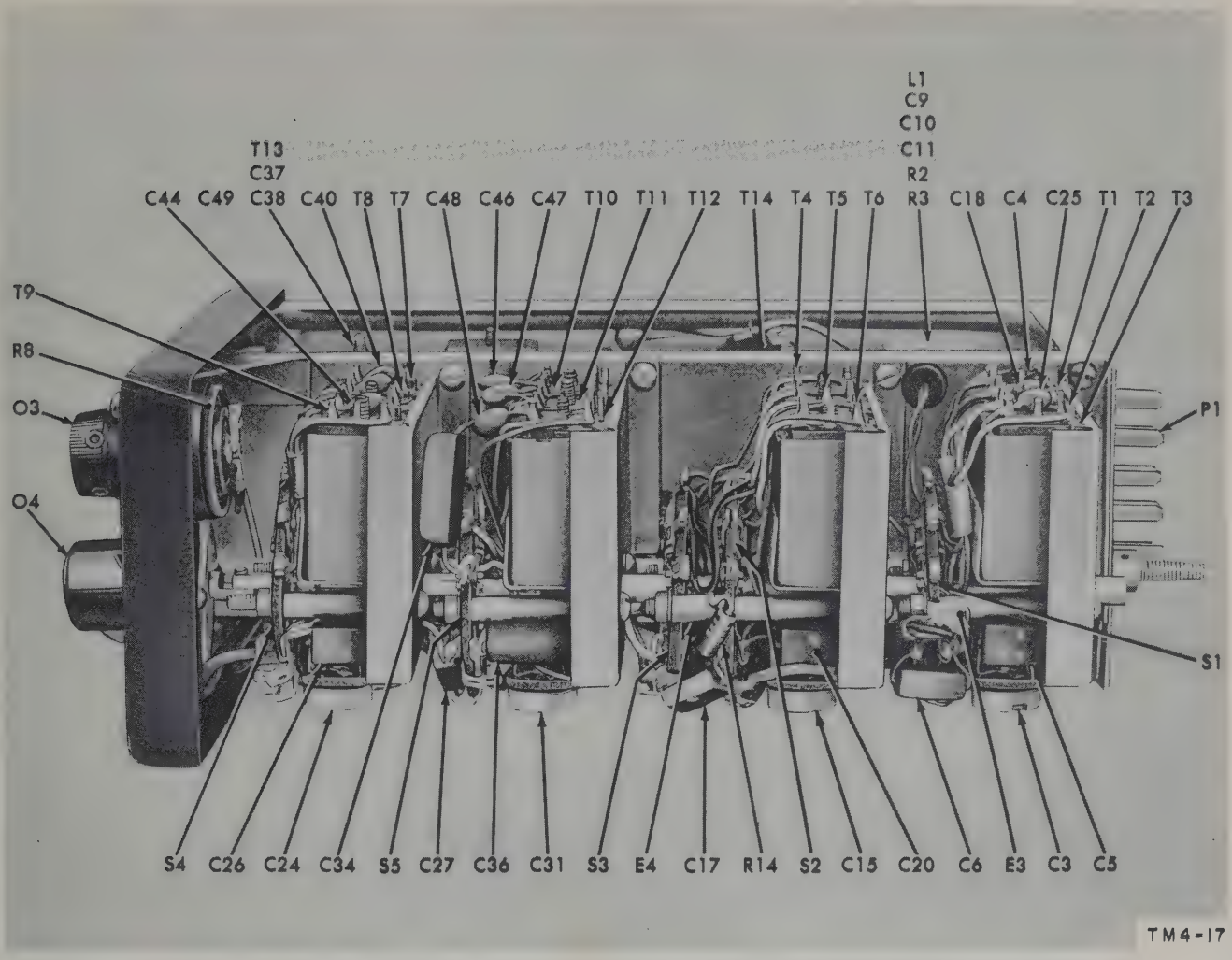


Figure 3-11. No. 702600 Tuner Unit, Side View

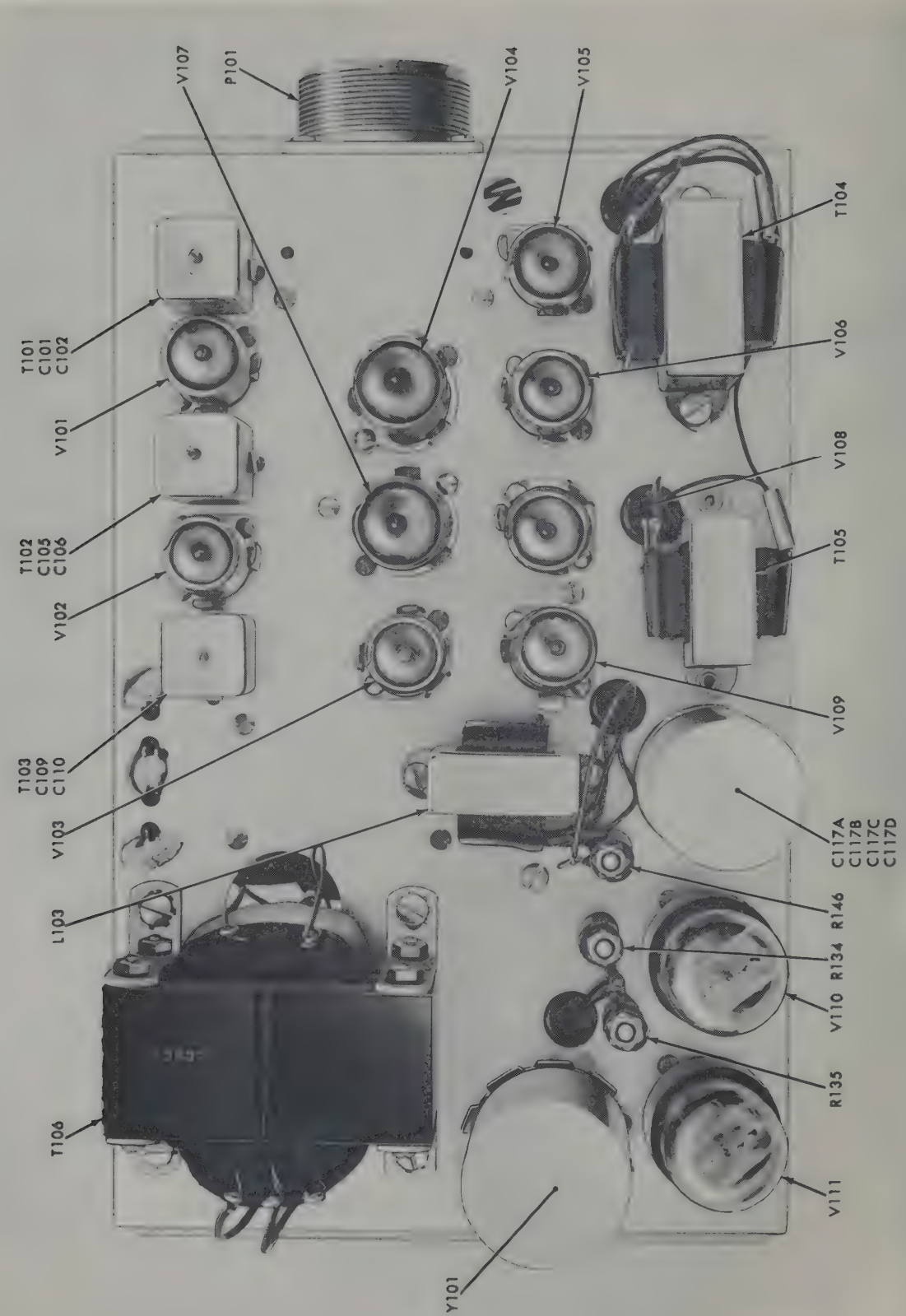
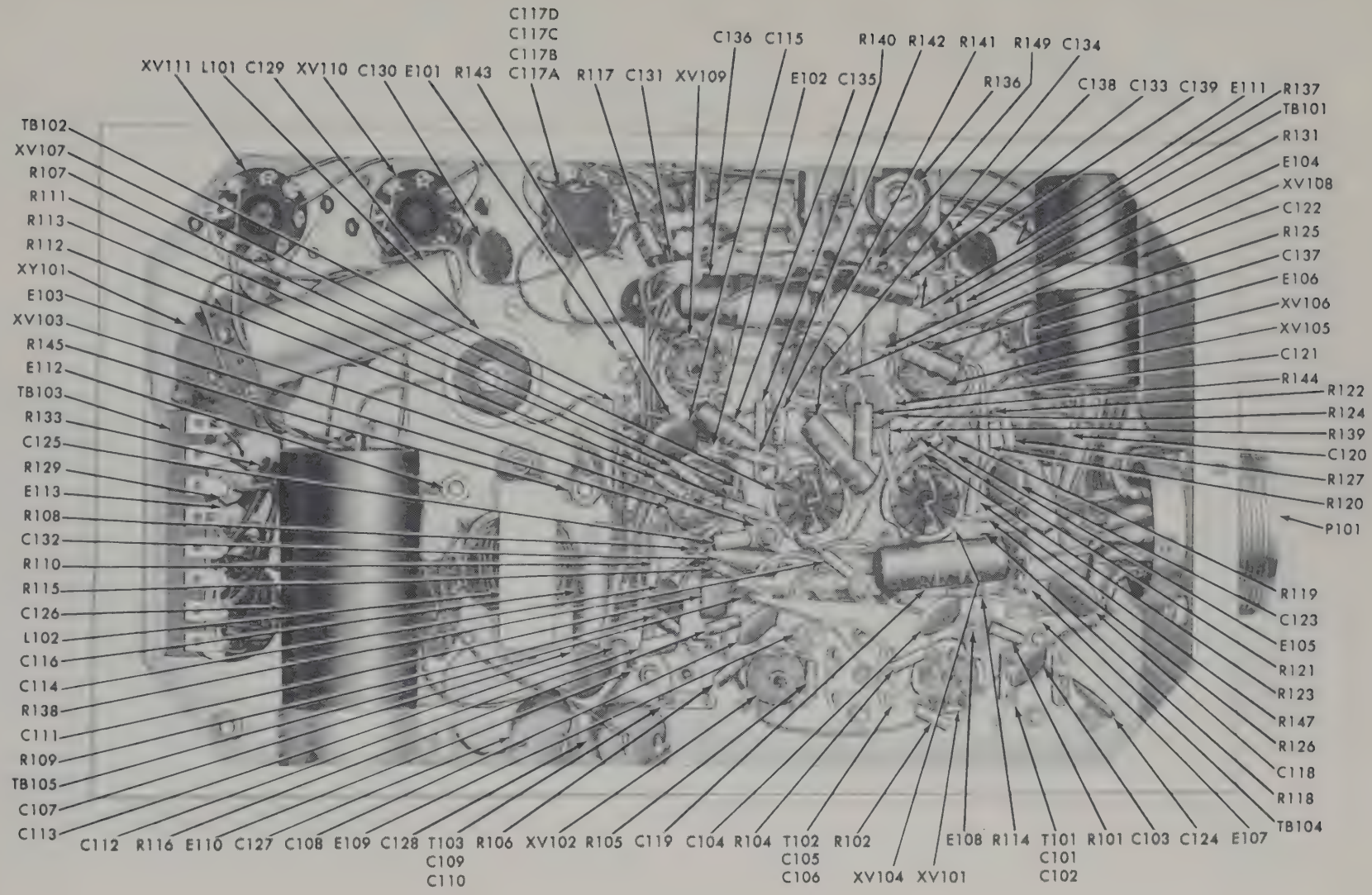
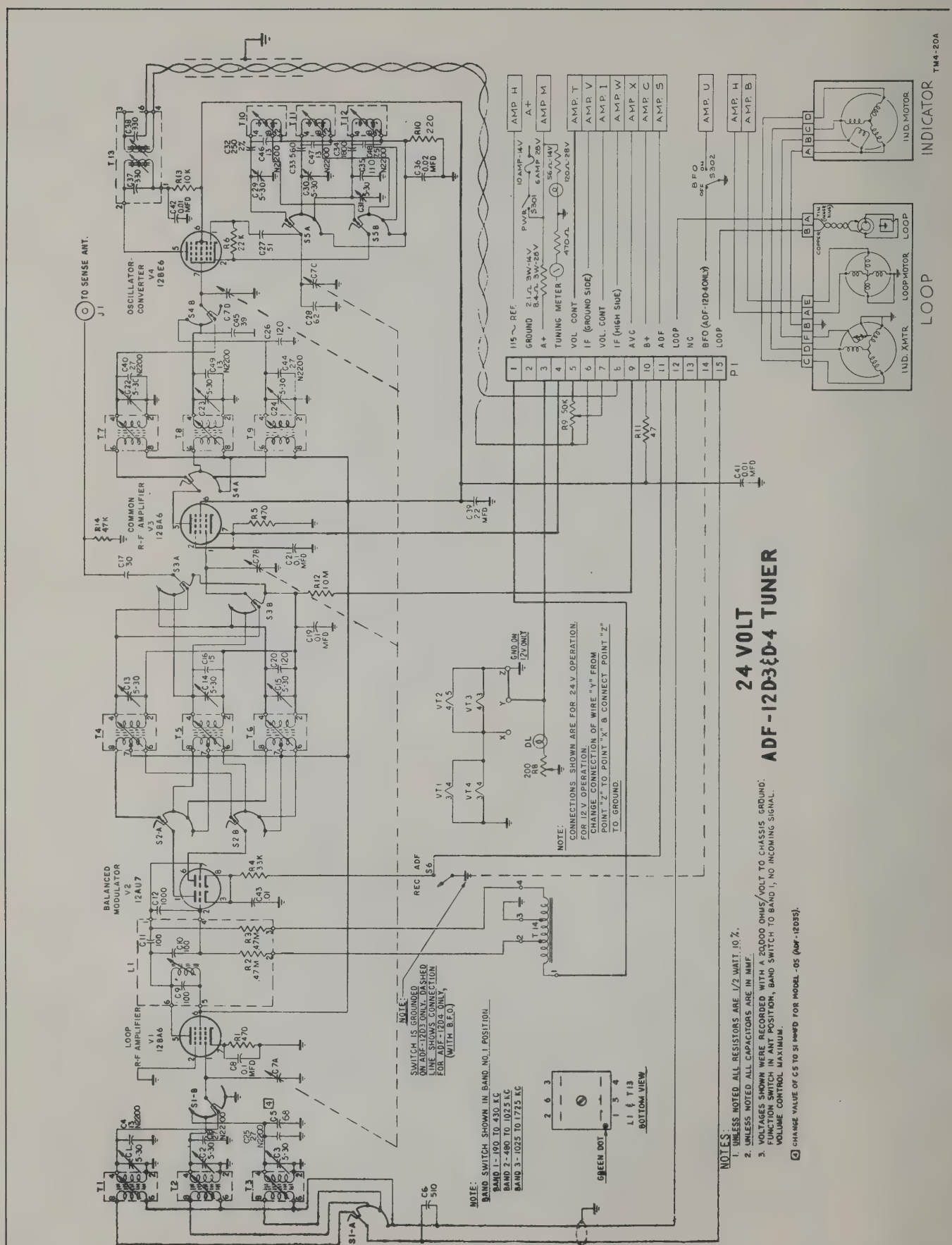


Figure 3-12. No. 702601 Amplifier Unit, Top View



TM4-19

Figure 3-13. No. 702601 Amplifier Unit, Bottom View


ADF-12D-3 & D-4 TUNER
24 VOLT
LOOP
INDICATOR
TM4-20A
TO SENSE ANT. J1
OSCILLATOR CONVERTER V4 12BE6
COMMON R-F AMPLIFIER V3 12BA6
LOOP R-F AMPLIFIER V1 12BA6
BALANCED MODULATOR V2 12AU7
REC ADF S6
P1
115~ REF.
GROUND
A+
TUNING METER
VOL. CONT
IF (GROUND SIDE)
VOL. CONT
IF (HIGH SIDE)
AVC
B+
ADF LOOP
NC
BFO (ADF-12D-4 ONLY)
LOOP
AMP. H
AMP. M
AMP. T
AMP. V
AMP. I
AMP. W
AMP. X
AMP. C
AMP. S
AMP. U
AMP. H
AMP. B
IND. MOTOR
IND. XMTR
LOOP MOTOR
NOTES:
1. UNLESS NOTED ALL RESISTORS ARE 1/2 WATT 10%.
2. UNLESS NOTED ALL CAPACITORS ARE IN MMF.
3. VOLTAGES SHOWN WERE RECORDED WITH A 20,000 OHMS/VOLT TO CHASSIS GROUND: FUNCTION SWITCH IN ANT POSITION, BAND SWITCH TO BAND I, NO INCOMING SIGNAL. VOLUME CONTROL MAXIMUM.
4 CHANGE VALUE OF C5 TO 51 MMFD FOR MODEL -05 (ADF-12D3S).
NOTE: SWITCH IS GROUNDED ON ADF-12D3 ONLY. DASHED LINE SHOWS CONNECTION FOR ADF-12D4 ONLY, (WITH B.F.O.)
NOTE: BAND SWITCH SHOWN IN BAND NO. 1 POSITION
BAND 1 - 190 TO 430 KC
BAND 2 - 490 TO 1025 KC
BAND 3 - 1025 TO 1725 KC
GREEN DOT
L1 & T13 BOTTOM VIEW
NOTE: CONNECTIONS SHOWN ARE FOR 24 V OPERATION. CHANGE CONNECTION OF WIRE "Y" FROM POINT "Z" TO POINT "X" & CONNECT POINT "Z" TO GROUND.
GND ON 12V ONLY
DL

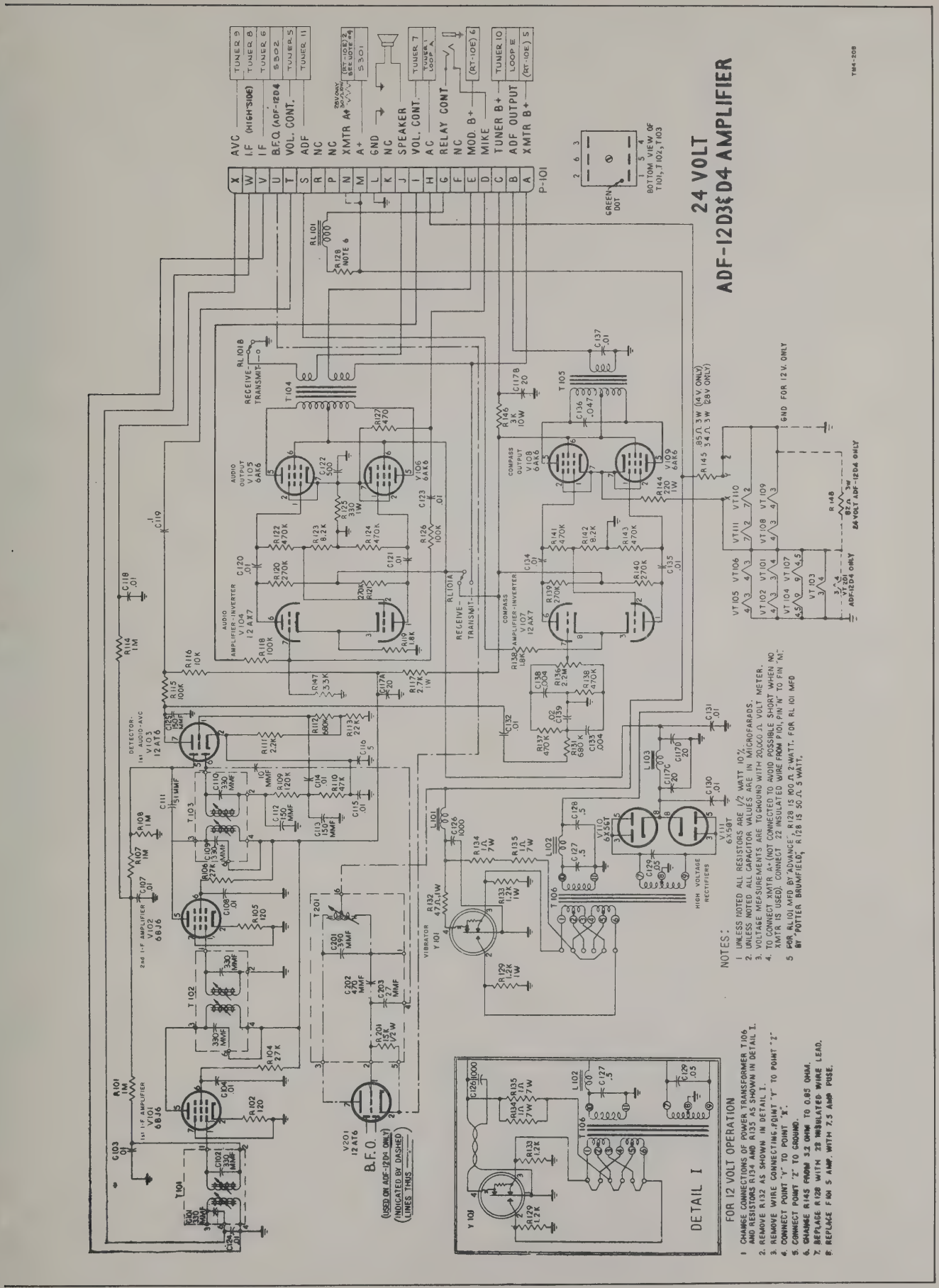
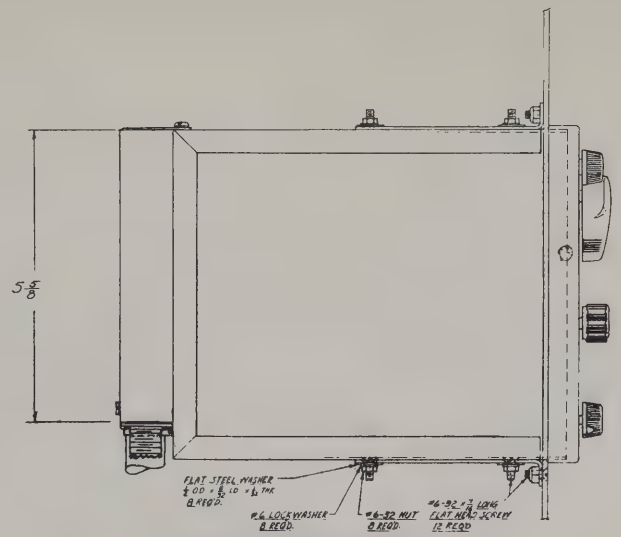

24 VOLT
ADF-12D3 & D4 AMPLIFIER
P-101
AVC
I.F. (HIGH SIDE)
I.F.
B.F.O. (ADF-12D4 ONLY)
VOL. CONT.
ADF
NC
XMTR A+
GND
NC
SPEAKER
VOL. CONT.
AC
RELAY CONT
NC
MOD. B+
MIKE
TUNER B+
ADF OUTPUT
XMTR B+
TUNER 9
TUNER 8
TUNER 6
S-302
TUNER 5
TUNER 11
TUNER 7
TUNER 1 LOOP A
TUNER 10
LOOP B
S-301
GREEN DOT
BOTTOM VIEW OF T101, T102, T103
GND FOR 12V. ONLY
24 VOLT ADF-12D4 ONLY
DETAIL I
FOR 12 VOLT OPERATION
NOTES:
1 UNLESS NOTED ALL RESISTORS ARE 1/2 WATT 10%.
2. UNLESS NOTED ALL CAPACITOR VALUES ARE IN MICROFARADS.
3. VOLTAGE MEASUREMENTS ARE TO GROUND WITH 20,000 Ω VOLT METER.
4. TO CONNECT XMTR A+ (NOT CONNECTED TO AVOID POSSIBLE SHORT WHEN NO XMTR IS USED). CONNECT .22 INSULATED WIRE FROM P101, PIN "N" TO PIN "M".
5 FOR RL101 MFD BY ADVANCE, R128 IS 100 Ω 2-WATT. FOR RL 101 MFD BY POTTER BRUMFIELD, R128 IS 50 Ω 5 WATT.
1. CHANGE CONNECTIONS OF POWER TRANSFORMER T106 AND RESISTORS R134 AND R135 AS SHOWN IN DETAIL I.
2. REMOVE R132 AS SHOWN IN DETAIL I.
3. REMOVE WIRE CONNECTING POINT "Y" TO POINT "Z"
4. CONNECT POINT "Y" TO POINT "X".
5. CONNECT POINT "Z" TO GROUND.
6. CHANGE R143 FROM 3.2 OHM TO 0.85 OHM.
7. REPLACE R120 WITH 2.2 INSULATED WIRE LEAD.
8. REPLACE F104 5 AMP. WITH 7.5 AMP FUSE.

Figure 3-14. Orienter Model ADF-12D3, D4 Schematic Diagram

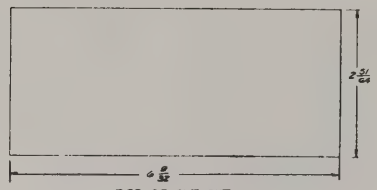
APPENDIX I

Installation Data. The installation drawings for the Orienter have been included with this manual for reference only. Fully detailed installation instructions are provided with each Orienter installation kit.

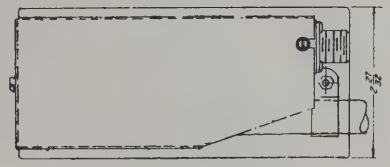
NO.	CHANGE ORDER NO.	CHANGE	BY	DATE	CHK
A	----	RELEASED	[illegible]	[illegible]	[illegible]

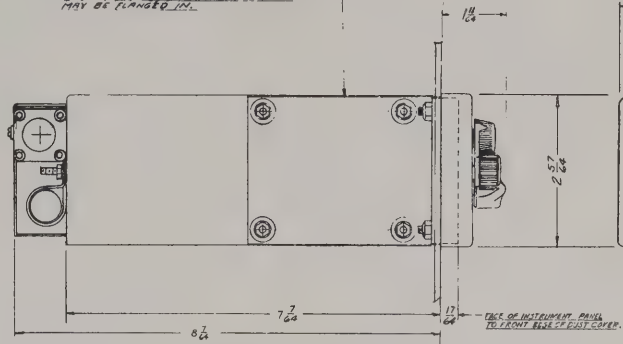


SUGGESTED METHODS OF INSTALLATION: ANGLES MAY BE ADDED TO TOP & BOTTOM OR TO SIDES; OR INSTRUMENT PANEL MAY BE FLANGED IN.



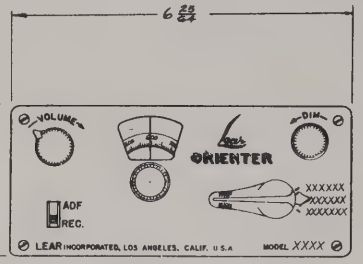
SIZE OF CUT-OUT





FACE OF INSTRUMENT PANEL TO FRONT BASE OF DUST COVER.

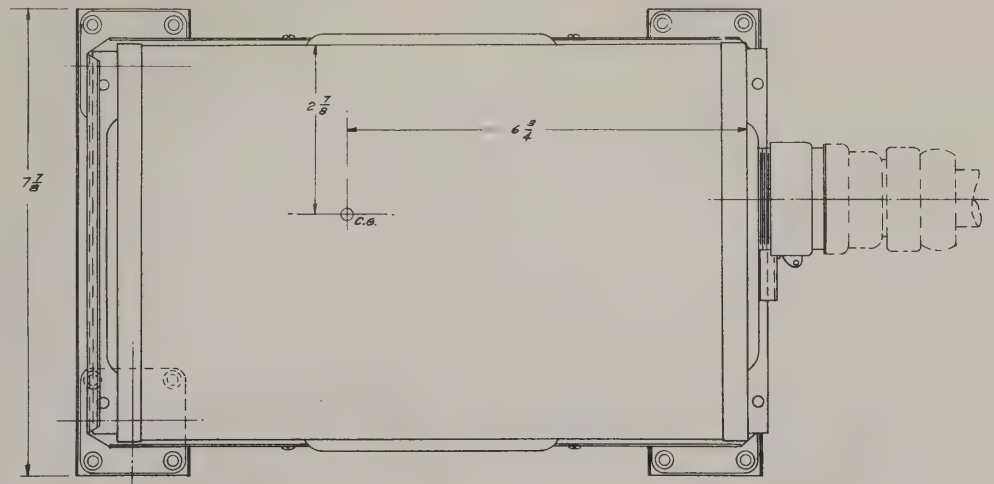
MOUNTING FACE

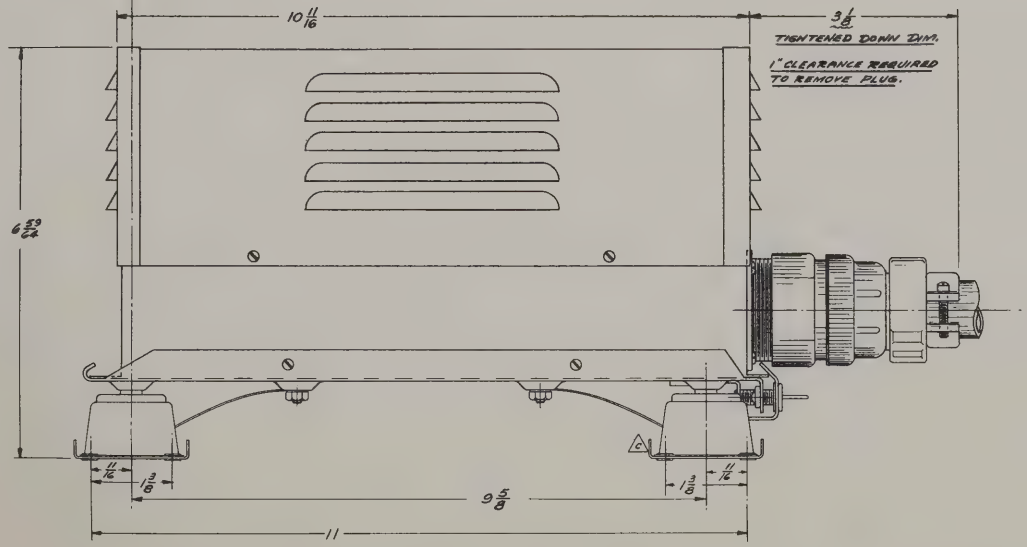


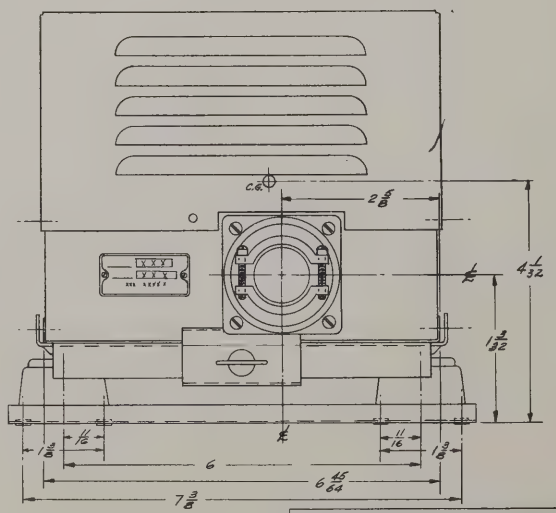
WEIGHT - LESS CABLE: 4.0 LB

BASIC MODEL ADF-122B/A			
NEXT ASSY			
MATERIAL		SPEC. NO.	
		DIMENSIONS	
MACHINE FINISHES		DO NOT SCALE DRAWING	
SCALE	LEAR INCORPORATED		
INSTALLATION DATA ADF-122B/A TUNER			702812

702812 A







NO.	CHANGE ORDER NO.	CHANGE	BY	DATE	CHK
C	4293	RE-DRAWN & SHOCK MOUNT ADDED	AD	9-16-57	

64139 C

WEIGHT-(LESS CABLE):10.0 LBS.

THE DESIGNS, CONSTRUCTIONS, ARRANGEMENTS, DISCLOSURES AND DEVICES SHOWN OR DESCRIBED IN THE PROPOSAL, DRAWINGS OR SKETCHES BEARING THIS LEGEND, ARE THE PROPERTY OF LEAR, INCORPORATED, AND ARE SUBMITTED IN CONFIDENCE WITH THE UNDERSTANDING THAT SUCH DESIGNS, CONSTRUCTIONS, ARRANGEMENTS, DISCLOSURES AND DEVICES SHALL NOT BE UTILIZED IN WHOLE OR IN PART BY ANY PERSON, FIRM OR CORPORATION WITHOUT THE PRIOR WRITTEN PERMISSION OF LEAR, INCORPORATED.

BASIC MODEL	ADF-12 C & D
ORIG. NEXT ASSY.	
FINISH	EXCEPT AS NOTED
QTY. / WT.	ACT WT.
MATERIAL	
SPEC. NO.	
HEAT TREAT	
SPEC. NO.	
FINISH	
SPEC. NO.	
CHECKED	D.W.B.
MATERIAL	
STRESS	
PRODUCTION	C.E. Lucas 11/12
DESIGN	
DRAWN	A.D. 9-16-57

LEAR, INC.
GRAND RAPIDS, MICH., U.S.A.

INSTALLATION DATA
ADF-12 AMPLIFIER

UNLESS OTHERWISE SPECIFIED
DIMENSIONS TO BE NET AFTER PLATING
C'SKNKS AND SPOTFACE .010 CORNER RADIUS
.010 RADIUS MINIMUM FILLET ON SHOULDERS
SHARP EDGES APPROX .005
REMOVE ALL BURRS
DIMENSIONS ARE IN INCHES AND TOLERANCES ARE:
FRACTIONS ±1/64 3 PLACE DECIMALS ±.005
2 PLACE DECIMALS ±.010 ANGULAR ±1°
SURFACE ROUGHNESS
125" - 250" ▽ 32 — 32" - 500" ▽ 125

SCALE FULL

DO NOT SCALE DRAWING

64139 C

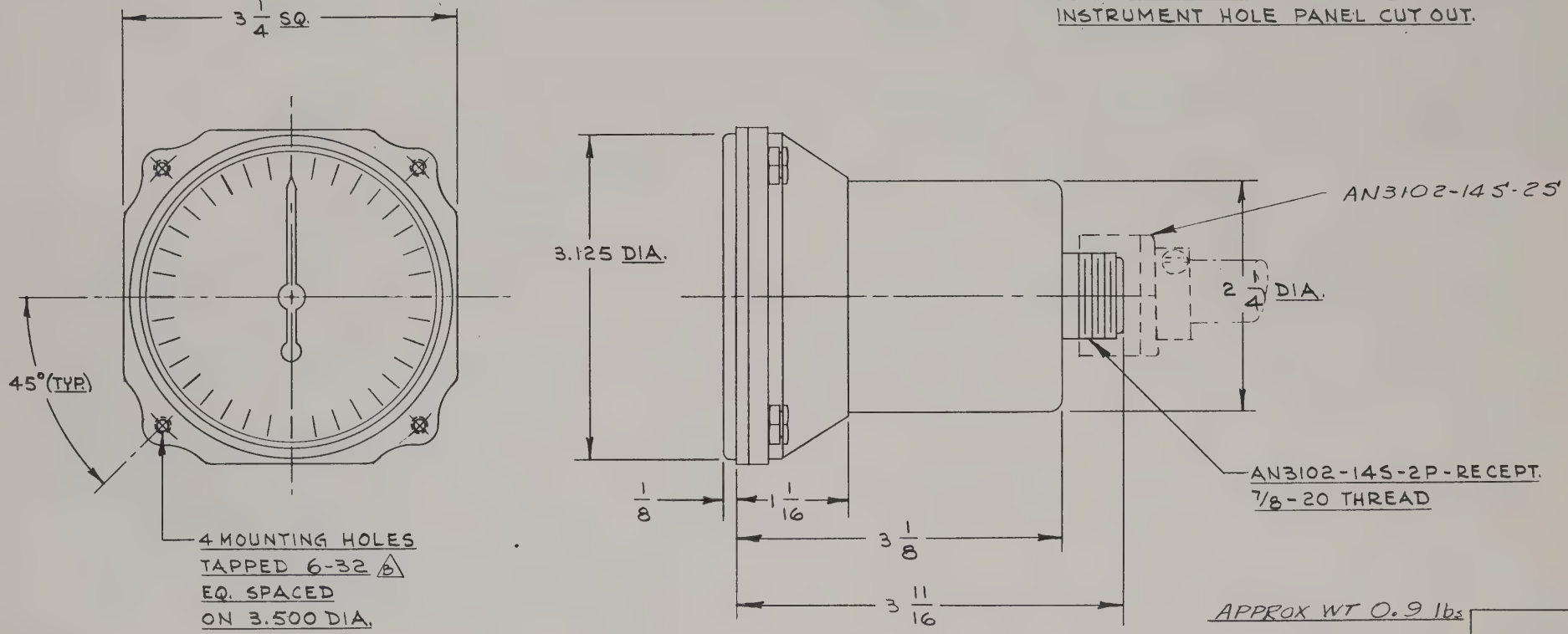
ISSUE	CHANGE ORDER NO.	CHANGE	DATE BY	CHK.

ISSUE	CHANGE ORDER NO.	CHANGE	DATE BY	CHK.

ISSUE	CHANGE ORDER NO.	CHANGE	DATE BY	CHK.
A	—	RELEASED	9/24/64	A.R

2330 DRAWING NO. A ISSUE

NOTE-
1- THIS INSTRUMENT MOUNTS IN STANDARD INSTRUMENT HOLE PANEL CUT OUT.



APPROX WT 0.9 lbs

INSTALLATION DWG MODEL 2330

UNLESS OTHERWISE SPECIFIED			
Dimensions apply after Plating and Heat Treating C'Bore and Spotface Corner Radii .010 Max. BREAK ALL EDGES .010 Dimensions are in inches and Tolerances are: Decimals ± .005; Fractions ± 1/64; Angles ± ½° Sheet Metal and Sand Casting Tolerances are: Fractions ± 1/32; Angles ± 1° SURFACE ROUGHNESS — RMS VALUE	EXP. LABS.		
	CHECKER	Art Romig	9/24/64
	CHIEF ENGR.		
	STRESS		
	MATERIALS		
	SALES		
	MFG.		
	DEVELOPMENT		
	PRODUCT		
	DESIGN		
SCALE — DO NOT SCALE DRAWING	DRAWN	P. GINDES	9/24/64

*=COMMERCIAL PART — SEE DETAIL DRAWING BEFORE ORDERING | WT. LB. | PART REF.

PART NO. | BASIC MODEL 2330

MATERIAL — | HEAT TREAT

FINISH —

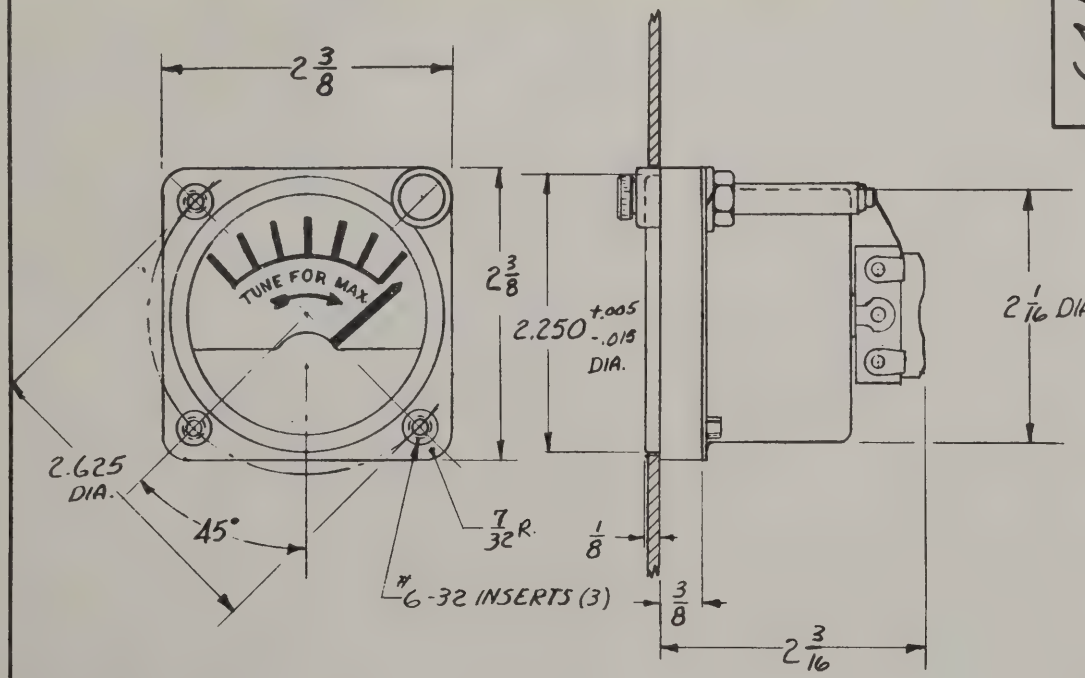
THE INFORMATION HEREON IS THE PROPERTY OF LEAR, INCORPORATED, AND IS FURNISHED FOR REFERENCE ONLY. UNAUTHORIZED USE THEREOF IS FORBIDDEN.

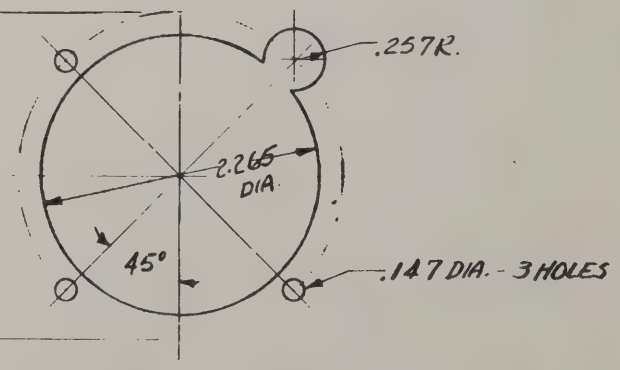
LEAR, INC.

DRAWING TITLE	CATEGORY	DWG. SIZE	DRAWING NO.
INSTALLATION DATA- COMPASS INDICATOR			2330 A

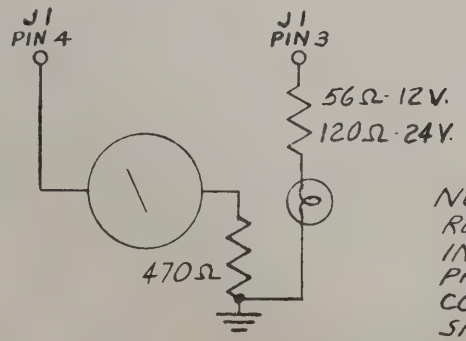
64195 B

NO.	CHANGE ORDER NO.	CHANGE	BY	DATE	CHK.
A	—	RELEASED		7-28-53	FW
B	7356	CHANGED SCHEMATIC NO. FROM 64134 TO 701154	HE B	12/3/53	A.T.





PANEL CUT OUT



NOTE:
REFER TO SCHEMATIC 701154
INSTALL METER ON INSTRUMENT PANEL IN CONVENIENT LOCATION.
CONNECT INDICATED WIRES AS SHOWN.

THE DESIGNS, CONSTRUCTIONS, ARRANGEMENTS, DISCLOSURES AND DEVICES SHOWN OR DESCRIBED IN THE PROPOSAL, DRAWINGS OR SKETCHES BEARING THIS LEGEND, ARE THE PROPERTY OF LEAR, INCORPORATED, AND ARE SUBMITTED IN CONFIDENCE WITH THE UNDERSTANDING THAT SUCH DESIGNS, CONSTRUCTIONS, ARRANGEMENTS, DISCLOSURES AND DEVICES SHALL NOT BE UTILIZED IN WHOLE OR IN PART BY ANY PERSON, FIRM OR CORPORATION WITHOUT THE PRIOR WRITTEN PERMISSION OF LEAR, INCORPORATED.

BASIC MODEL ADF-12
NEXT ASS'Y 63945 PL

MACHINE FINISHES
(2) EXTRA SMOOTH MACHINE (4) ROUGH MACHINE
(1) FINISH GRIND (3) SMOOTH MACHINE

EST. WT. | ACT. WT.

APPROVED		7-21
CHECKER		
STRESS CHK		
PROJ. ENG.		
DRAWN BY	GFK	7/21/53

SCALE 1:1

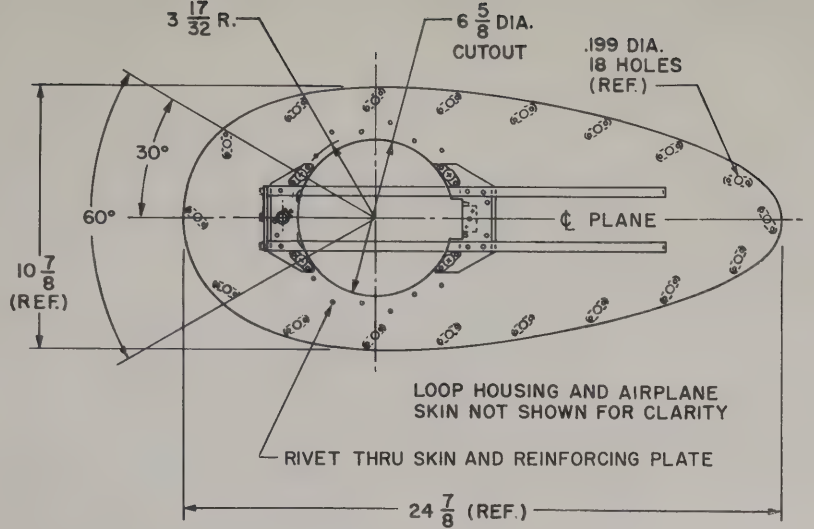
MATERIAL | SPEC. NO. | SUPERSEDES
HEAT TREAT | SPEC. NO.
FINISH | SPEC. NO.
DO NOT SCALE DRAWING

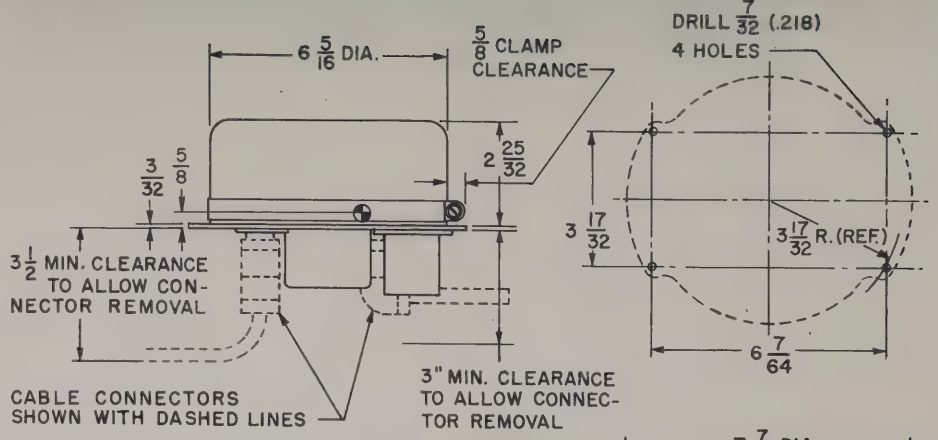
LEAR, INC.

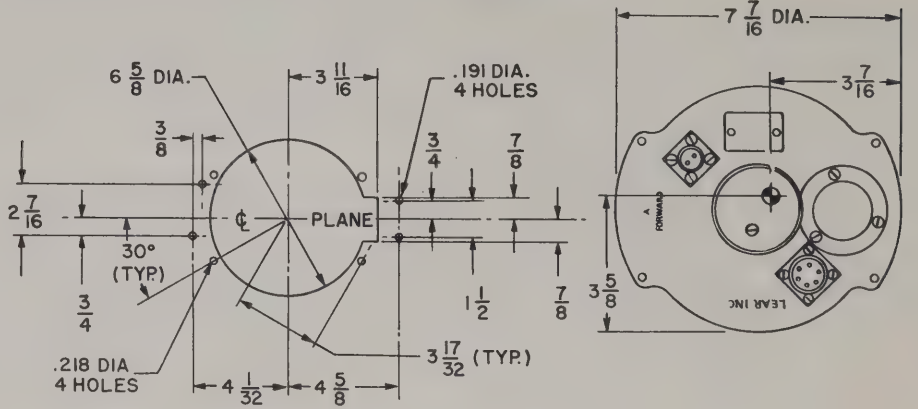
INSTALLATION DATA - TUNING METER

UNLESS OTHERWISE SPECIFIED
DIMENSIONS TO BE MET BEFORE PLATING
C'BORES AND SPOTFACE .010 CORNER RADIUS
.010 RADIUS MINIMUM FILLET ON UNDERCUTS
BREAK SHARP EDGES APPROX. .010 REMOVE ALL BURRS
DIMENSIONS ARE IN INCHES AND TOLERANCES ARE:
FRACTIONS ±1/64; 3 PLACE DECIMALS ±.005
4 PLACE DECIMALS ±.0005; ANGULAR ±1/2°
SHEET METAL
10° - 20° ±1/32 20° - 30° ±3/64

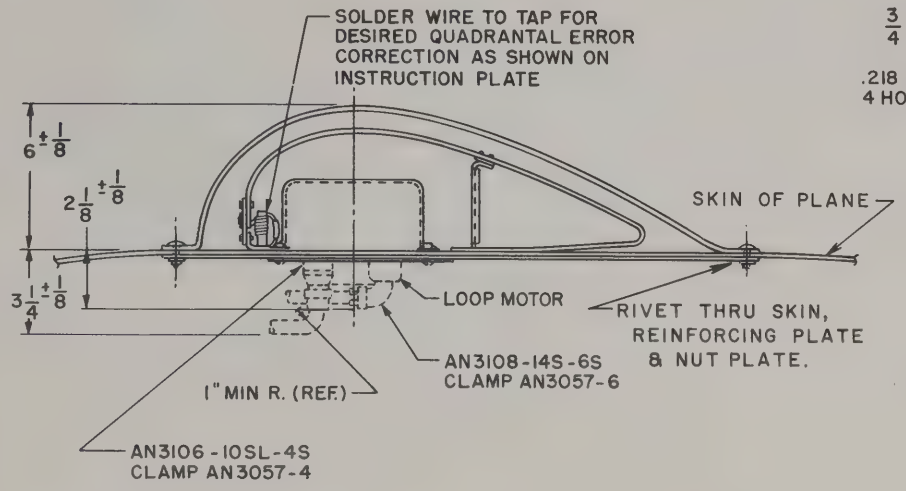
64195





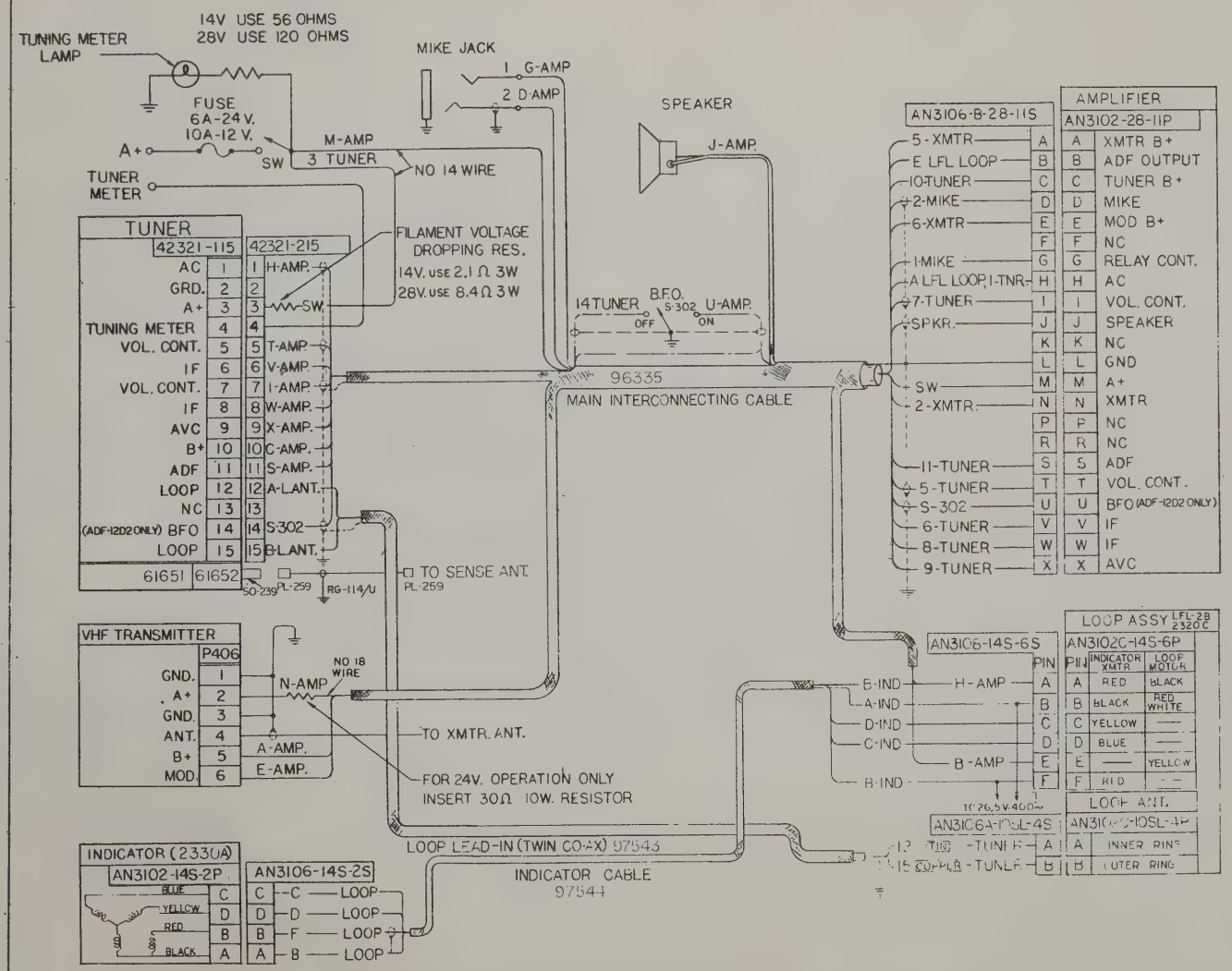


TYPICAL SKIN CUTOUT FOR LOOP INSTALLATION


SOLDER WIRE TO TAP FOR DESIRED QUADRANTAL ERROR CORRECTION AS SHOWN ON INSTRUCTION PLATE
6 ± 1/8
2 1/8 ± 1/8
3 1/4 ± 1/8
SKIN OF PLANE
LOOP MOTOR
RIVET THRU SKIN, REINFORCING PLATE & NUT PLATE.
AN3108-14S-6S CLAMP AN3057-6
1" MIN R. (REF.)
AN3106-10SL-4S CLAMP AN3057-4

NOTES:

1. LOOP ASSEMBLY MUST BE INSTALLED EXACTLY ON THE LONGITUDINAL ℄ OF AIRCRAFT TO GIVE CORRECT BEARINGS.
2. IF UNIT IS INSTALLED ON BELLY OF AIRCRAFT, DRILL A 3/8 DIA. HOLE AT LOWEST POINT OF THE HOUSING TO ALLOW DRAINAGE.
3. WHEN UNIT IS MOUNTED ON A CURVED SURFACE, REINFORCING PLATE MUST BE FORMED SO THAT THE LOOP ASSEMBLY IS MOUNTED ON A FLAT SURFACE.
4. JUNCTURES OF CONTACT SURFACES EXPOSED TO ELEMENTS SHOULD BE WEATHERPROOFED WITH SUITABLE SEAL.
5. SYNCHRO SHAFT POSITION IS FACTORY ADJUSTED IN CORRECT POSITION. IF NECESSARY TO RE-ADJUST, REFER TO INSTRUCTION BOOK FOR DETAILED INSTRUCTIONS.



7. FOR INSTALLATIONS USING 2320C LOOP SYNCHRO OPERATION OF 26.5 V. 400 C.P.S. FROM EXTERNAL SOURCE IS SHOWN. INTERNAL SYNCHRO VOLTAGE MAY BE OBTAINED BY SHORTING PIN A & F

6. B.F.O. USED WITH ADF-12D-4 ONLY. SWITCH CONNECTIONS SHOWN IN DASH LINES. (— - — -)

NOTES:

1. CONNECTIONS SHOWN ARE FOR THE LOOP MOUNTED UPRIGHT.
2. WHEN THE LOOP IS MOUNTED INVERTED, AS WHEN MOUNTED ON BELLY OF SHIP, CONNECTIONS C-IND & D-IND ARE TO BE REVERSED AT IND XMTR.
3. ALL WIRES NO.22 STRANDED UNLESS OTHERWISE INDICATED SHIELDED WIRES INDICATED BY DASHED LINES.
4. FILAMENT VOLTAGE DROPPING RESISTORS FOR TUNER AND TRANSMITTER ARE MOUNTED BEHIND THE RESPECTIVE DUST COVERS.
5. XMTR A+ CONNECTION IN AMPLIFIER PIN "N" TO PIN "M" MUST BE MADE BEFORE OPERATING XMTR. SEE AMPLIFIER SCHEMATIC DWG # 702814

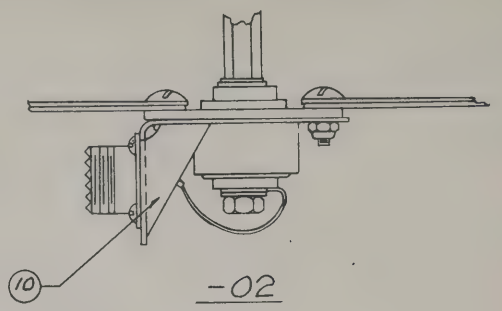
INTERCONNECTING WIRING DIAGRAM ADF-12-D3&D4 ADFM-12D-3&D4

APPLICABLE SCHEMATICS:
TUNER - 702811 XMTR - 96507
AMP - 702814 LOOP - 701003

LEAR, INC., LEARCAL DIVISION 3171 S. BUNDY DRIVE, SANTA MONICA, CALIFORNIA, U.S.A.

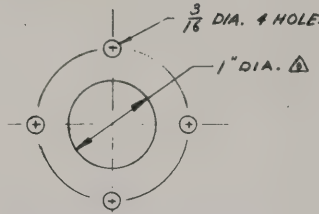
ADF-12 D3,D4 | 702809 | REV. B

ISSUE	CHANGE ORDER NO.	CHANGE	DATE BY	CHK.
D	——	ADDED -02	11-18-58 WRF	
A	—	RELEASED	4/4/64	B
B	9871	SEE E.C.O.	5-27-65 RLS	S
C	—	PICTURE CHANGE	6-24-69 CPR	JBS

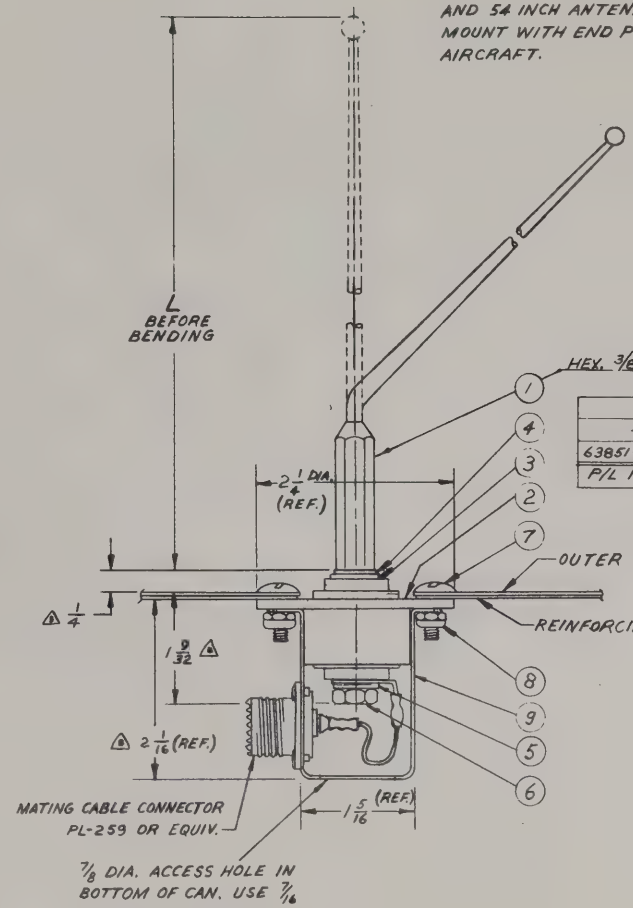


-02

27½ INCH ANTENNA IS STRAIGHT. 22 INCH AND 54 INCH ANTENNAS ARE BENT 45°. MOUNT WITH END POINTING TO AFT OF AIRCRAFT.



CUT OUT IN SKIN OF AIRPLANE



BASIC

P/L NO.	WHIP PART NO.	L	KIT WT.	APPLICATION
-54	50213	54"	10 OZ.	ADF SENSE/L.F.RCVR.
-27½	62657-02	27½"	6 OZ.	VHF RCVR
63851-22	62657-01	22"	6 OZ.	VHF XMTR

63851-

D

ITEM	PART NO.	BASIC -02 REQ		DESCRIPTION	PART No.
10	703739	-	1	MOUNT RECEPTACLE	
9	701774	1	-	COVER ASSY.	
8	AN365-832	4	4	NUT, STOP	
7	Q5813-08-11	4	4	SCREW	
6	59020	1	1	SCREW 1/4-28 x 2	
5	56200	1	1	WASHER, LOCK	
4	42309-006	1	1	WASHER, FLAT	
3	63825	1	1	WASHER, NEOPRENE	
2	63930	1	1	MOUNTING	
1	SEE TABLE	1	1	WHIP	

UNLESS OTHERWISE SPECIFIED
Dimensions apply after Plating and Heat Treating
C' Bore and Spotface Corner Radii .010 Max.
BREAK ALL EDGES
BURR CLASSIFICATION No. . . . . .
Dimensions are in inches and Tolerances are:
Decimals ± .005; Fractions ± 1/64; Angles ± ½°
Fractions ± 1/32; Angles ± 1° Between Sand Cast Surfaces or Sheet Metal Surfaces
SURFACE ROUGHNESS OF ALL MACHINED SURFACES √ RMS

MATERIAL NOTED
FINISH —
HEAT TREAT —

⊕ — COMMERCIAL PART — SEE DETAIL DRAWING BEFORE ORDERING

WT.	LB.	PART REF.	BASIC MODEL ADF-12

SCALE FULL — DO NOT SCALE DRAWING

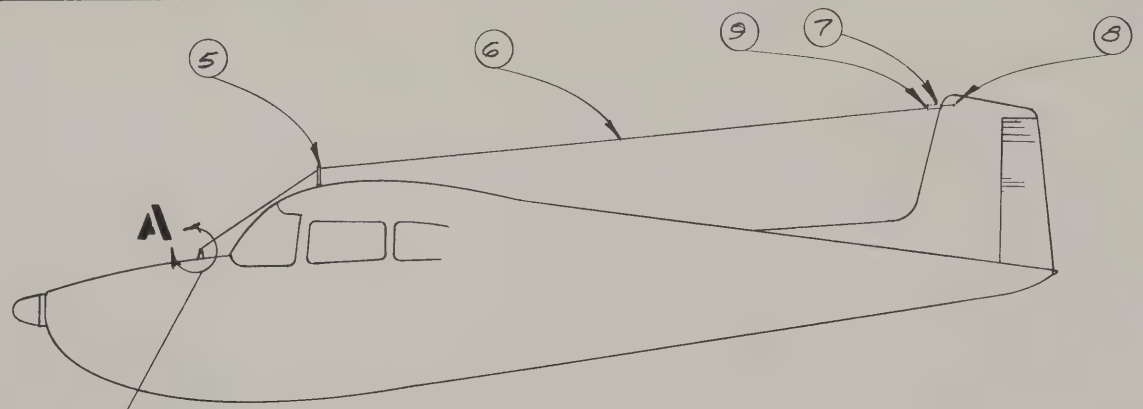
LEAR, INCORPORATED
GRAND RAPIDS, MICHIGAN. U.S.A.

MET.		
DWN.	C Kelman	6/19/58
CHK'D	G. Burgard	6/20/58
APP.	C.K. Smith	6/23/58

DRAWING TITLE: INSTALLATION DATA - SHOCK MOUNTED WHIP ANTENNA

CATEGORY | DWG | DRAWING NO.
SIZE C — 63851

ISSUE	CHANGE ORDER NO.	CHANGE	DATE BY	CHK.	ISSUE	CHANGE ORDER NO.	CHANGE	DATE BY	CHK.	ISSUE	CHANGE ORDER NO.	CHANGE	DATE BY	CHK.	ISSUE	CHANGE ORDER NO.	CHANGE	DATE BY	CHK.

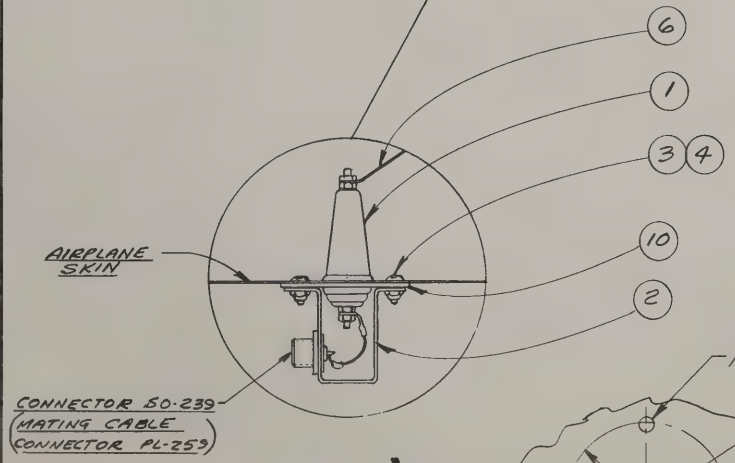


STRAIGHT WIRE ANTENNA

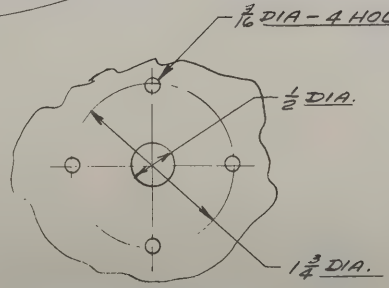
TYPICAL INSTALLATION

ADF SENSE OR LF RCVR ANTENNA

703743



DETAIL A



CUTOUT IN SKIN OF AIRPLANE

REQ.	ITEM	PART NO.	DESCRIPTION
1	10	702121	PLATE - REINFORCING
1	9	1545	INSULATOR
1	8	63951	CLIP
1	7	1540	SPRING - COMPRESSION
20'	6	1579	WIRE - #18 ANTENNA
1	5	703799	BRACKET ASSY. - STANDOFF
4	4	AN365-832	NUT #8-32
4	3	Ø5813-08-11	SCREW #8-32 x 11/16 LG.
1	2	701774	COVER ASSY.
1	1	1528	ANTENNA FEED THRU-INSULATOR

PART No.

The information hereon is the property of Lear, Incorporated, and is submitted in confidence for reference only. Unauthorized use by anyone for any other purpose is forbidden.

UNLESS OTHERWISE SPECIFIED
Dimensions apply after Plating and Heat Treating
C" Bore and Spotface Corner Radii .010 Max.
BREAK ALL EDGES
BURR CLASSIFICATION No.
Dimensions are in Inches and Tolerances are:
Decimals ± .005, Fractions ± 1/64, Angles ± ½°
Fractions ± 1/32, Angles ± 1° Between Sand Cast Surfaces or Sheet Metal Surfaces
SURFACE ROUGHNESS OF ALL MACHINED SURFACES √ RMS

MATERIAL
FINISH
HEAT TREAT

④ — COMMERCIAL PART — SEE DETAIL DRAWING BEFORE ORDERING | WT. | LB. | PART REF. | BASIC MODEL

SCALE — DO NOT SCALE DRAWING

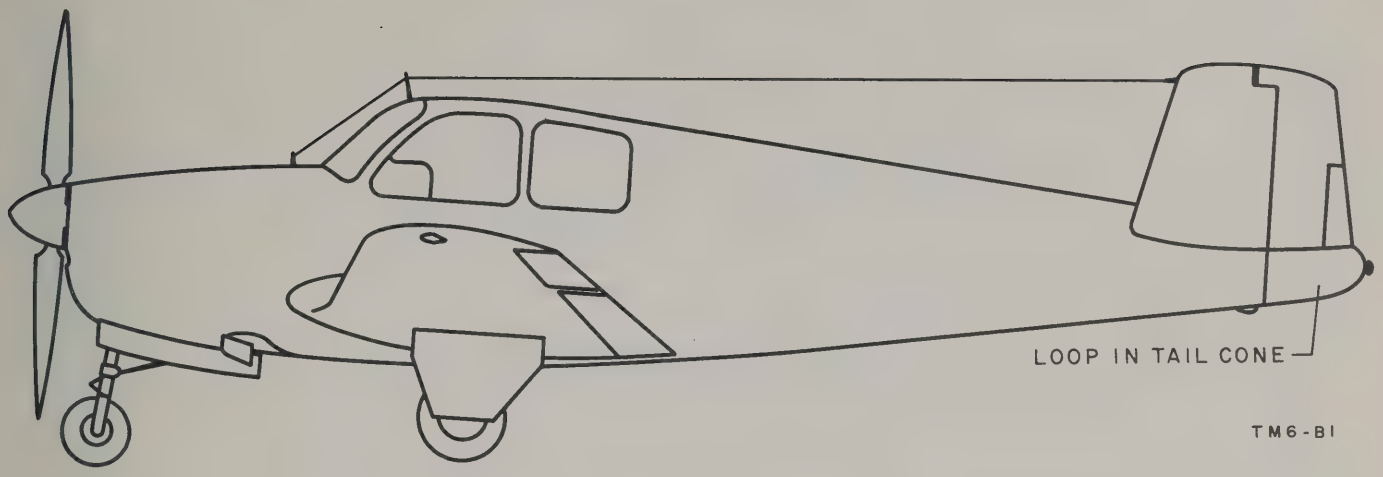
LEAR, INCORPORATED GRAND RAPIDS, MICHIGAN. U.S.A.

MET.		
DWN.	LOWEN	3-25-55
CHKR	MC	4-1-55
APP.	O.J. SUMMERS	4/12/55

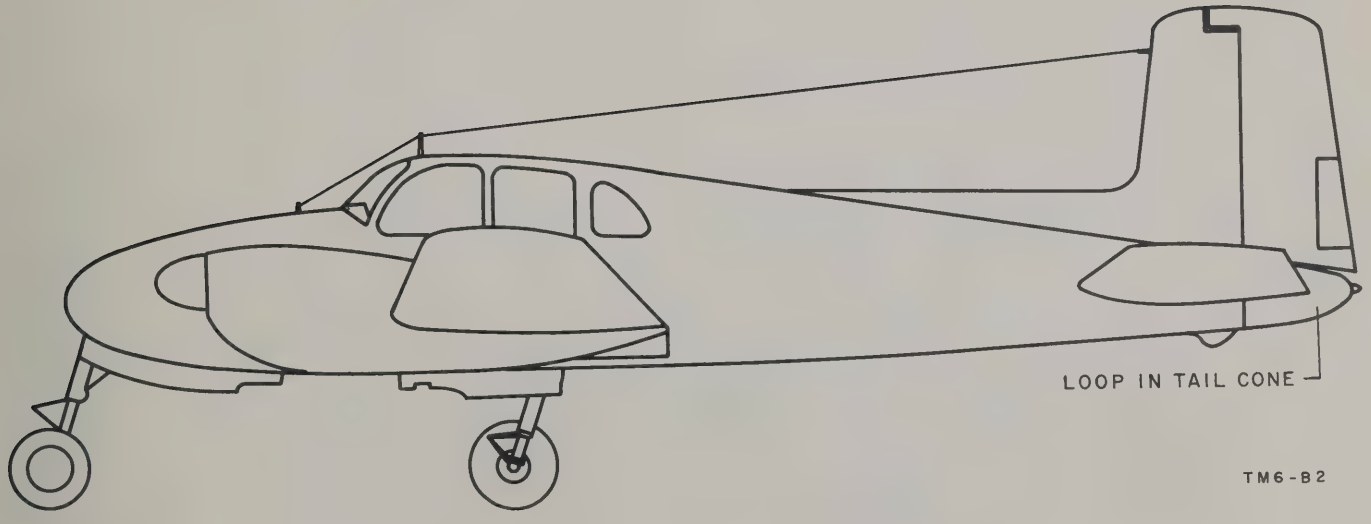
DRAWING TITLE: INSTALLATION DATA ANTENNA

CATEGORY: | DWG SIZE: C | DRAWING NO.: 703743

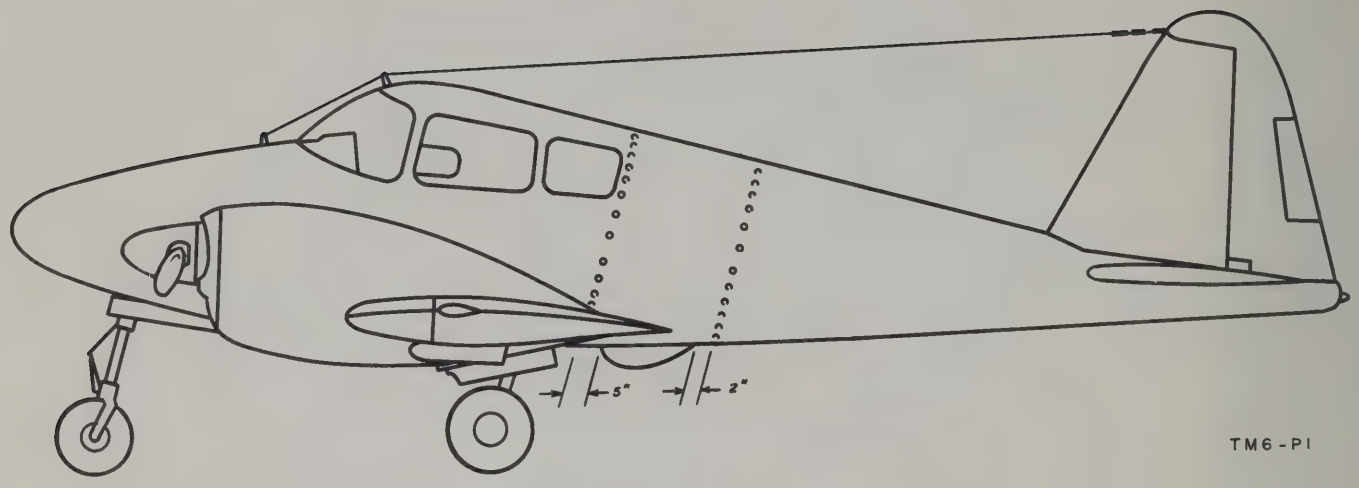
THOMAS 3000 #70213 12 54



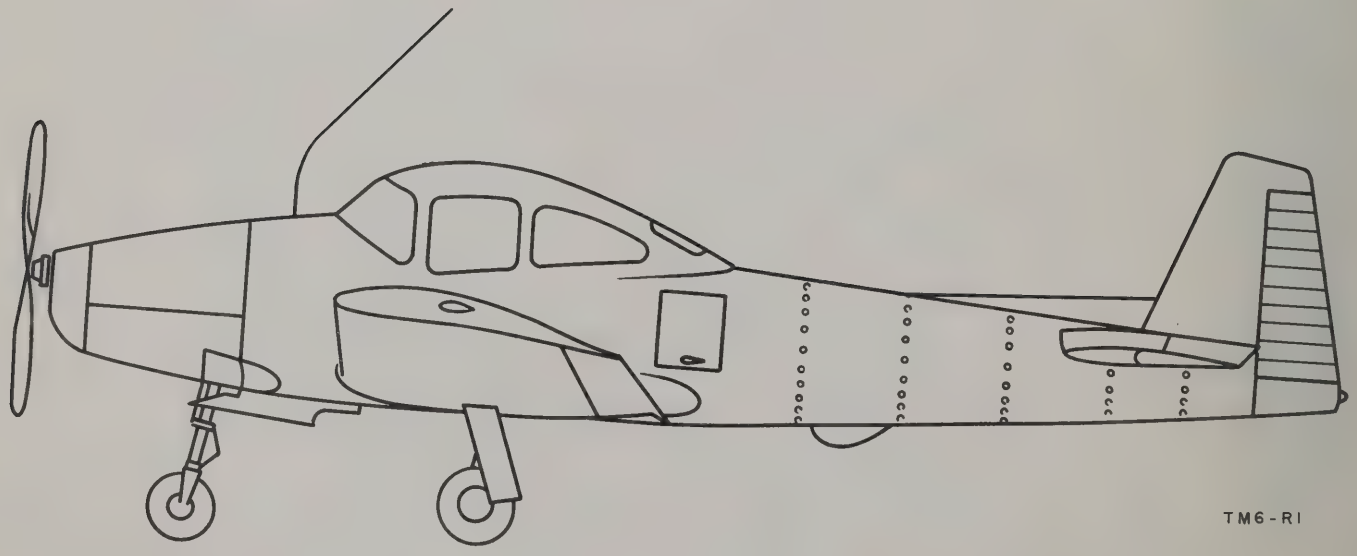
TM6-B1



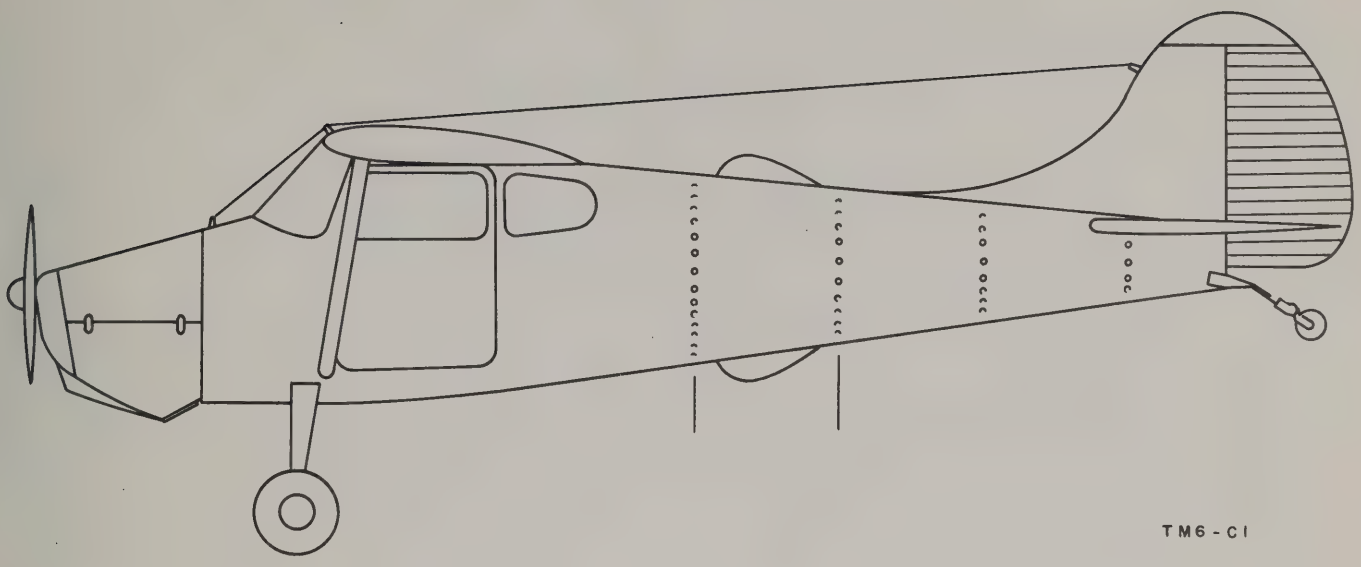
TM6-B2



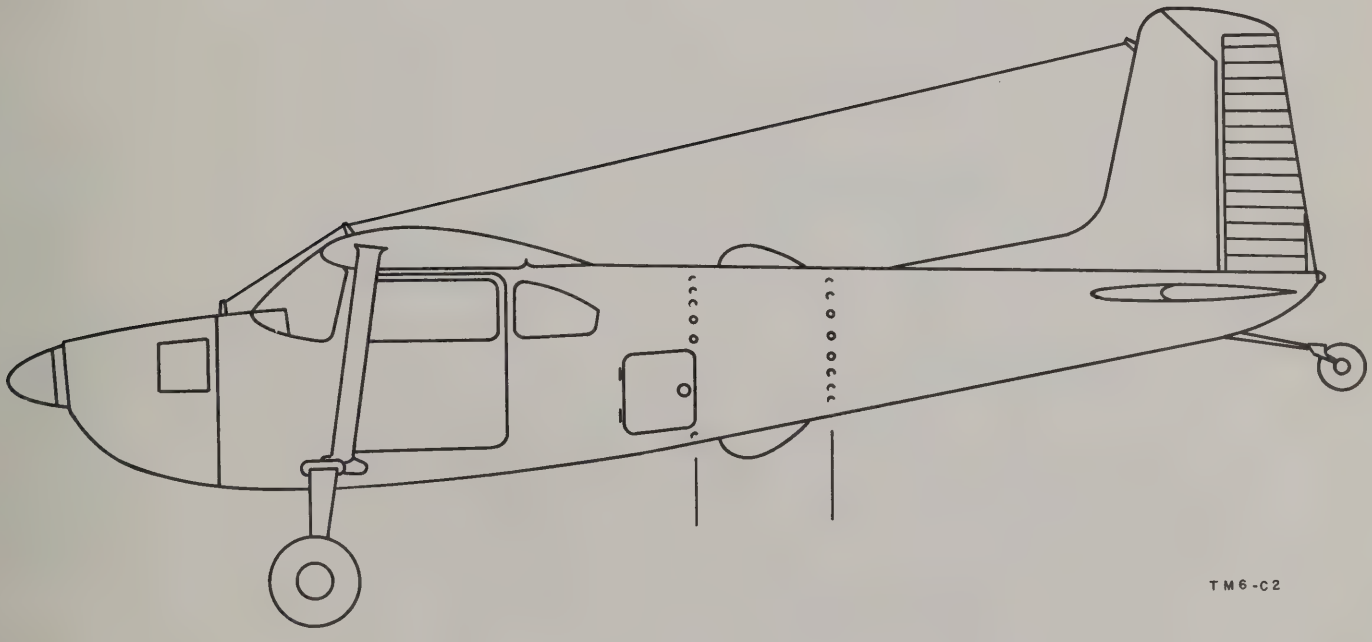
TM6-P1



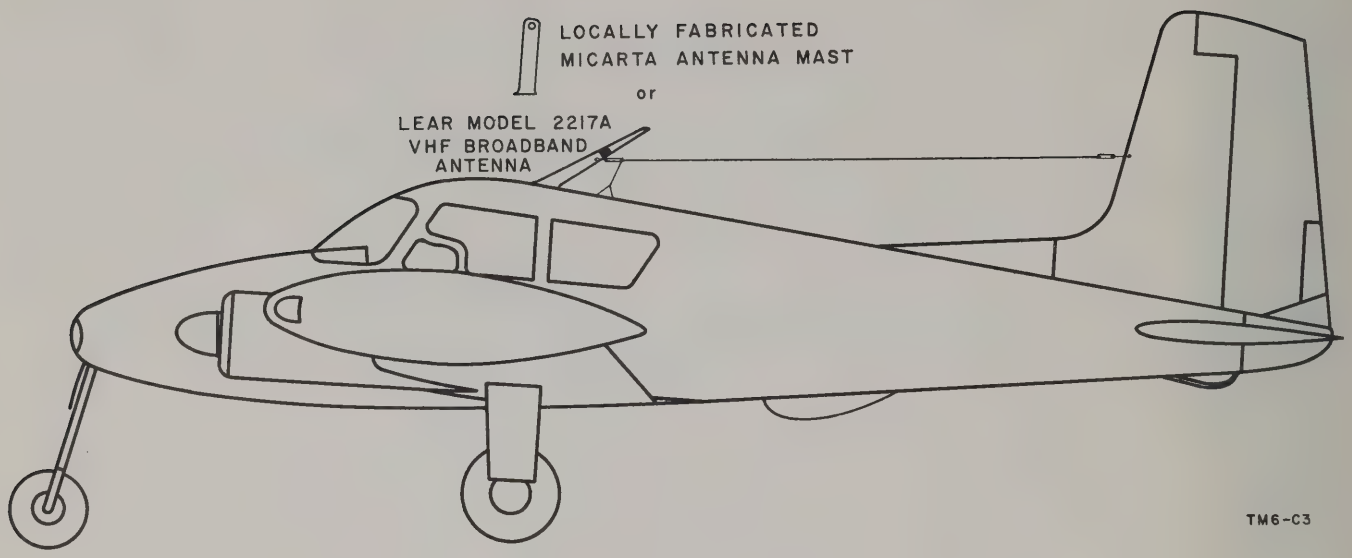
TM6-R1

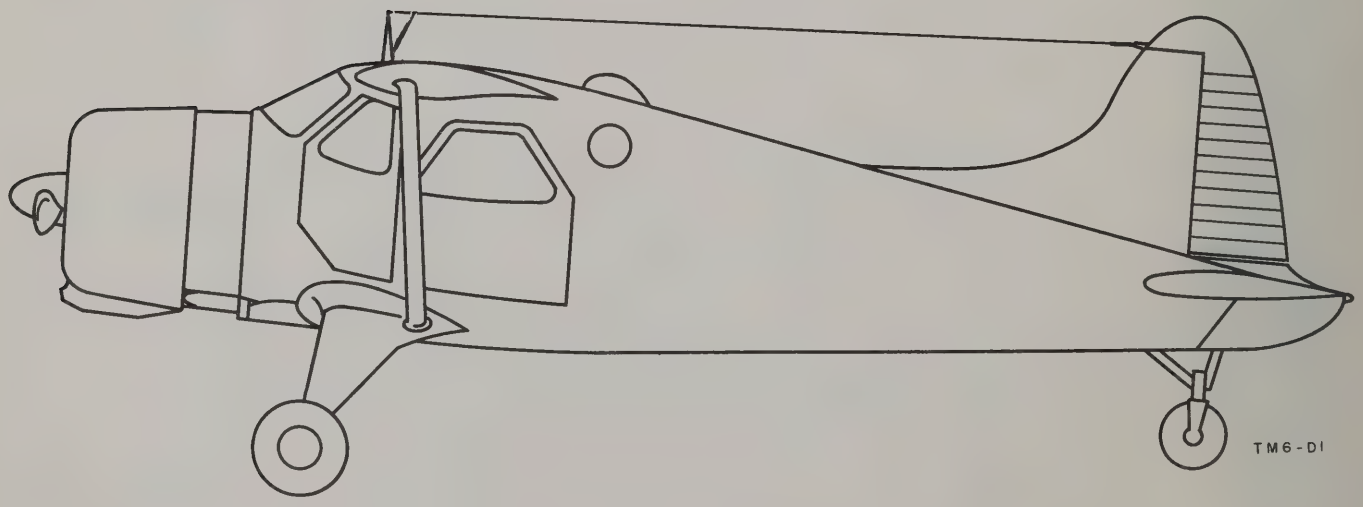


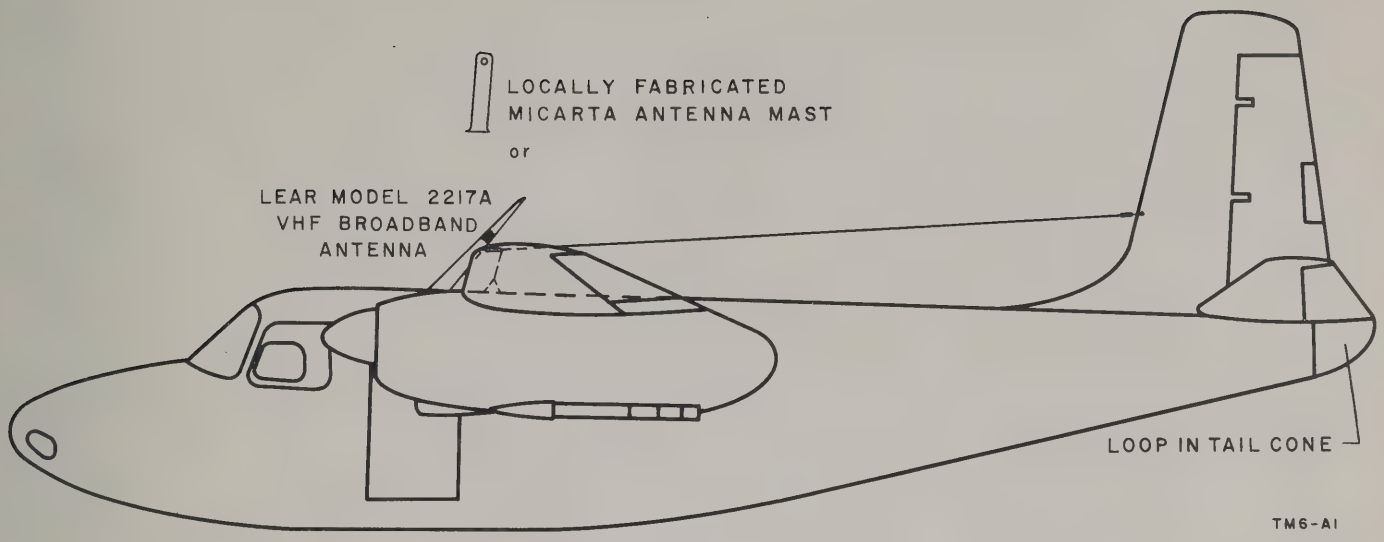
TM6-C1

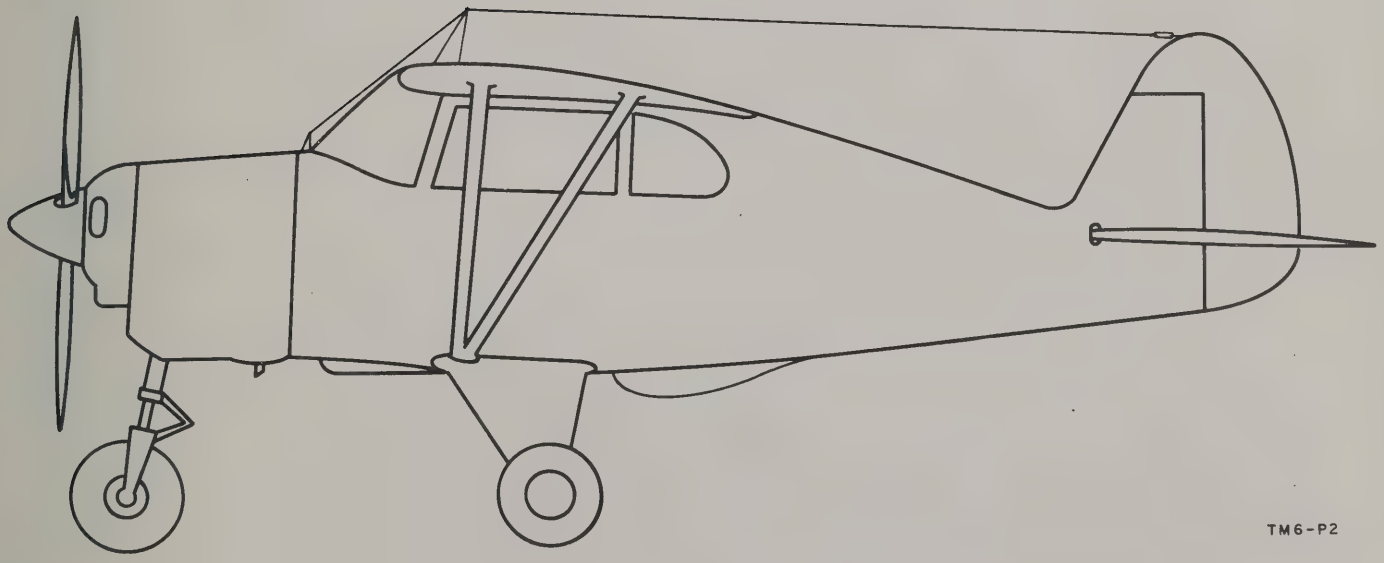


TM6-C2


LOCALLY FABRICATED
MICARTA ANTENNA MAST
or
LEAR MODEL 2217A
VHF BROADBAND
ANTENNA
TM6-C3


TM6-D1


LOCALLY FABRICATED
MICARTA ANTENNA MAST
or
LEAR MODEL 2217A
VHF BROADBAND
ANTENNA
LOOP IN TAIL CONE
TM6-A1


TM6-P2

APPENDIX II

PARTS LISTS

TUNER UNIT PARTS LIST

Symbol Number	Description	Function	Lear Part Number	Qty per Equipment
Series 1-99	Tuner (ORIENTER ADF-12D-3, without Beat Frequency Oscillator) 6- 25/64 w X 2- 57/64 h X 9- 11/64 in. lg. 14 VDC at 5.8 amps or 28 VDC at 3.1 amps	"Head end" of the radio receiver. Contains RF amplifiers, oscillator, converter. Mounts all controls except OFF-ON switch.	702600-01 (14 V) 702600-02 (28 V)	1
	Tuner (ORIENTER ADF-12D-4 with Beat Frequency Oscillator) dimensions same. 14 VDC at 5.8 amps or 28 VDC at 1.3 amps		702600-03 (14 V) 702600-04 (28 V)	
C1	Capacitor, Variable; Ceramic Dielectric; 5-30 uuf 350 WVDC temp coef N750	T1 tuning, pins 2 and 4 (band 1)	63433-01	12
C2	Same as C1	T2 tuning, pins 2 and 4 (band 2)	-	-
C3	Same as C1	T3 tuning, pins 2 and 4 (band 3)	-	-
C4	Capacitor, Fixed; Ceramic Dielectric; 13 uuf ±15% 500 WVDC temp coef N2200	Temperature compensates resonant circuit T1-C1	701684-02	4
C5	Capacitor, Fixed; Mica Dielectric; 68 uuf ±10% 300 WVDC	T3 tuning	CM15C68OK	1
C6	Capacitor, Fixed; Mica Dielectric; 510 uuf ±5% 300 WVDC	Balances loop and lead-in reactance at S1A	CM15C511J	1
C7	Capacitor, Variable; Air Dielectric; 12.6 to 452 uuf, tolerance of section 2 +1% +1 uuf, tolerance between sections ±0.5% +1 uuf	Main tuning	63415-05	1
C8	Capacitor, Fixed; Paper Dielectric; 0.1 uf ±10% 200 WVDC	V1 cathode bypass	96214-01	2
C9	Capacitor, Fixed; 100 uuf	L1 tuning; p/o L1	-	-
C10	Capacitor, Fixed; 100 uuf	RF coupling, DC blocking; p/o L1	-	-
C11	Capacitor, Fixed; 100 uuf	RF coupling, DC blocking; p/o L1	-	-
C12	Capacitor, Fixed; Paper Dielectric; 1000 uuf ±5% 600 WVDC	T14 shunt across control grids of V2	91078-102-J6	1
C13	Same as C1	T4 tuning, pins 2 and 4 (band 1)	-	-
C14	Same as C1	T5 tuning, pins 2 and 4 (band 2)	-	-
C15	Same as C1	T6 tuning, pins 2 and 4 (band 3)	-	-
C16	Capacitor, Fixed; Mica Dielectric; 15 uuf ±5% 300 WVDC	T5 tuning	CM15C15OJ	1
C17	Capacitor, Fixed; Mica Dielectric; 30 uuf ±5% 300 WVDC	AVC blocking between S3A and sense antenna	CM15C300J	1

TUNER UNIT PARTS LIST (cont)

Symbol Number	Description	Function	Lear Part Number	Qty per Equipment
C18	Capacitor, Fixed; Ceramic Dielectric; 27 uuf ±5% 500 WVDC temp coef N2200	Temperature compensates resonant circuit T2-C2	701684-03	4
C19	Capacitor, Fixed; Disc, Ceramic Dielectric; 0.01 uf min value 500 WVDC	AVC decoupling between R12 and T6, pin 2	90732-07	4
C20	Capacitor, Fixed; Mica Dielectric; 120 uuf ±5% 300 WVDC	T6 tuning	CM15C121J	2
C21	Same as C8	V3 cathode bypass	-	-
C22	Same as C1	T7 tuning, pins 2 and 4 (band 1)	-	-
C23	Same as C1	T8 tuning, pins 2 and 4 (band 2)	-	-
C24	Same as C1	T9 tuning, pins 2 and 4 (band 3)	-	-
C25	Same as C18	Temperature compensates resonant circuit T3-C3	-	-
C26	Same as C20	T9 tuning	-	-
C27	Capacitor, Fixed; Mica Dielectric; 51 uuf ±10% 300 WVDC	V4 oscillator tank coupling to control grid	CM15C51OK	1
C28	Capacitor, Fixed; Mica Dielectric; 62 uuf ±5% 300 WVDC	V4 suppressor tuning	CM15C620J	1
C29	Same as C1	T10 tuning, between S5A and C32 (band 1)	-	-
C30	Same as C1	T11 tuning, between S5A and C33 (band 2)	-	-
C31	Same as C1	T12 tuning, between S5A and C34 (band 3)	-	-
C32	Capacitor, Fixed; Mica Dielectric; 250 uuf ±2% 300 WVDC	T10 tuning, pin 4	CM15D251G	1
C33	Capacitor, Fixed; Mica Dielectric; 560 uuf ±2% 300 WVDC	T11 tuning, pin 4	CM20D561G	1
C34	Capacitor, Fixed; Mica Dielectric; 1800 uuf ±2% 500 WVDC	T12 tuning, pin 4	CM30D182G	1
C35	Capacitor, Fixed; Mica Dielectric; 110 uuf ±5% 300 WVDC	T12 tuning	CM15C111J	1
C36	Capacitor, Fixed; Paper Dielectric; 0.02 uf +30% -10% 200 WVDC	V4 cathode bypass	42367-209	1
C37	Capacitor, Fixed; 330 uuf	T13 primary tuning; p/o T13	-	-
C38	Capacitor, Fixed; 330 uuf	T13 secondary tuning; p/o T13	-	-
C39	Capacitor, Fixed; Paper Dielectric; 0.22 uf ±20% 200 WVDC	B+ decoupling	91079-224-M2	1

TUNER UNIT PARTS LIST (cont)

Symbol Number	Description	Function	Lear Part Number	Qty per Equipment
C40	Same as C18	Temperature compensates resonant circuit T7-C22	-	-
C41	Same as C19	B+ decoupling	-	-
C42	Same as C19	V4 plate bypass	-	-
C43	Same as C19	V2 cathode bypass	-	-
C44	Same as C18	Temperature compensates resonant circuit T9-C24	-	-
C45	Capacitor, Fixed; Mica Dielectric; 39 uuf ±5% 300 WVDC	T8 tuning	CM15C390J	1
C46	Same as C4	Temperature compensates resonant circuit T10-C29	-	-
C47	Same as C4	Temperature compensates resonant circuit T11-C30	-	-
C48	Capacitor, Fixed; Ceramic Dielectric; 7.5 uuf ±5% 500 WVDC temp coef N2200	Temperature compensates resonant circuit T12-C31	701684-01	1
C49	Same as C4	Temperature compensates resonant circuit T8-C23	-	-
DL1	Lamp, Panel; 14V 0.1 amp	Panel illumination (14V units only)	59339-02	1
	Lamp, Panel; 28V 0.17 amp	(28V units only)	4383	
E1	Lug, Terminal	Cable Clamp	50472	2
E2	Same as E1	Cable Clamp	-	-
E3	Lug, Terminal	Soldering terminal	62569-02	2
E4	Same as E3	Soldering terminal	-	-
E5	Lug, Terminal	Cable Clamp	71844	1
J1	Connector, Receptacle; 1 pin, female	Sense antenna connector mating with P303	61651	1
L1	Coil, Phase	Retards loop antenna signal phase 90° between V1 and V2	96450-01	1
O1	Knob	Tuning control	63815-01B	1
O2	Knob	Volume control	63127-01B	1
O3	Knob	Dimmer control	63738-01B	1
O4	Knob	Band change control	63864	1
P1	Connector, Receptacle; 15 pin, male	Connects Tuner Unit to Amplifier Unit and loop antenna; mates with P304	42321-115	1

TUNER UNIT PARTS LIST (cont)

Symbol Number	Description	Function	Lear Part Number	Qty per Equipment
R1	Resistor, Fixed; Composition; 470 ohm ±10% 1/2 W	V1 cathode bias	57072	2
R2	Resistor, Fixed; 470,000 ohm	V2 grid bias; p/o L1	-	-
R3	Resistor, Fixed; 470,000 ohm	V2 grid bias; p/o L1	-	-
R4	Resistor, Fixed; Composition; 33,000 ohm ±10% 1/2 W	V2 cathode bias	57094	1
R5	Same as R1	V3 cathode bias	-	-
R6	Resistor, Fixed; Composition; 22,000 ohm ±10% 1/2 W	V4 suppressor grid leak	57092	1
R7	Not used	-	-	-
R8	Resistor, Variable; Wire Wound; 200 Ohm 2W	Panel light dimmer	62395	1
R9	Resistor, Variable; Composition; 50,000 ohm ±20% 1/4W	Volume control	63200-08	1
R10	Resistor, Fixed; Composition; 220 ohm ±10% 1/2W	T11 V4 suppressor filter	57068	1
R11	Resistor, Fixed; Composition; 47 ohm ±10% 1/2W	B+ decoupling	57060	1
R12	Resistor, Fixed; Composition; 1 megohm ±10% 1/2W	AVC decoupling	57112	1
R13	Resistor, Fixed; Composition; 10,000 ohm ±10% 1/2W	V4 plate load	57088	1
R14	Resistor, Fixed; Composition; 47,000 ohm ±10% 1/2W	Sense antenna matching impedance	57096	1
S1	Switch Section, Rotary; Oak type H, 12 contact	Band selector	63420	5
S2	Same as S1	Band selector	-	-
S3	Same as S1	Band selector	-	-
S4	Same as S1	Band selector	-	-
S5	Same as S1	Band selector	-	-
S6	Switch, Slide, SPST; 3 amp 125V rating	Function switch	702539	1
T1	Transformer, RF	Loop antenna coupling to V1 (band 1)	701227-010	1
T2	Transformer, RF	Loop antenna coupling to V1 (band 2)	701227-050	1
T3	Transformer, RF	Loop antenna coupling to V1 (band 3)	701227-090	1

TUNER UNIT PARTS LIST (cont)

Symbol Number	Description	Function	Lear Part Number	Qty per Equipment
T4	Transformer, RF	Couples V2 to V3 (band 1)	701227-020	1
T5	Transformer, RF	Couples V2 to V3 (band 2)	701227-060	1
T6	Transformer, RF	Couples V2 to V3 (band 3)	701227-100	1
T7	Transformer, RF	Couples V3 to V4 (band 1)	701227-040	1
T8	Transformer, RF	Couples V3 to V4 (band 2)	701227-080	1
T9	Transformer, RF	Couples V3 to V4 (band 3)	701227-120	1
T10	Coil, RF	Oscillator tank inductance	701227-030	1
T11	Coil, RF	Oscillator tank inductance	701227-070	1
T12	Coil, RF	Oscillator tank inductance	701227-110	1
T13	Transformer, IF	V4 output coupling	97606	1
T14	Transformer, AF	Shifts vibrator output 90° and couples it to V2	63699	1
TB1	Terminal Board; 3 lug	Soldering terminals	4749	1
V1	Electron Tube; 12BA6	Loop RF amplifier	60303	2
V2	Electron Tube; 12AU7, twin triode	Balanced modulator	62305	1
V3	Same as V1	Common RF amplifier	-	-
V4	Electron Tube; 12BE6, pentagrid converter	Oscillator-converter	60304	1
XDL1	Socket, Panel Lamp	Mounts lamp DL1	96454	1
XV1	Socket, Miniature Tube; 7 pin	Mounts V1	62244-07	3
XV2	Socket, Miniature Tube; 9 pin	Mounts V2	62234-05	1
XV3	Same as XV1	Mounts V3	-	-
XV4	Same as XV1	Mounts V4	-	-

AMPLIFIER UNIT PARTS LIST

Symbol Number	Description	Function	Lear Part Number	Qty per Equipment
Series 100 - 199	Amplifier (ORIENTER ADF-12D3 without Beat Frequency Oscillator) 6- 59/64 h X 12 lg X 7- 5/8 in. w (including shockmount) 14 VDC at 5.8 amps or 28 VDC at 3.1 amps	Contains IF amplifiers, detector, AVC detector, audio output, compass output and power supply circuits	702601-01 (14V) 702601-02 (28V)	1
	Amplifier (ORIENTER ADF-12D4 with Beat Frequency Oscillator) dimensions same 14 VDC at 5.8 amps or 28 VDC at 3.1 amps		702601-03 (14V) 702601-04 (28V)	
	Mounting, Amplifier	Amplifier shockmount	96052	1
C101	Capacitor, Fixed; 330 uuf	T101 primary tuning; p/o T101	-	-
C102	Capacitor, Fixed; 330 uuf	T101 secondary tuning; p/o T101	-	-
C103	Capacitor, Fixed; Disc, Ceramic Dielectric; 0.01 uf min value 500 WVDC	AVC decoupling	90732-07	13
C104	Same as C103	V101 screen grid decoupling	-	-
C105	Capacitor, Fixed; 330 uuf	T102 primary tuning; p/o T102	-	-
C106	Capacitor, Fixed; 330 uuf	T102 secondary tuning; p/o T102	-	-
C107	Same as C103	AVC decoupling	-	-
C108	Same as C103	V102 screen grid decoupling	-	-
C109	Capacitor, Fixed; 330 uuf	T103 primary tuning; p/o T103	-	-
C110	Capacitor, Fixed; 330 uuf	T103 secondary tuning; p/o T103	-	-
C111	Capacitor, Fixed; Mica Dielectric; 51 uuf ±10% 300 WVDC	Couples portion of V102 output to AVC detector section of V103	CM15C510K	1
C112	Capacitor, Fixed; Tubular, Ceramic Dielectric; 150 uuf, ±10% 600 WVDC	V103 detector filter	42353-309A	3
C113	Same as C112	V103 detector filter	-	-
C114	Capacitor, Fixed; Paper Dielectric; 0.01 uf ±10% 400 WVDC	V103 coupling, detector to amplifier, pin 1	91079-103-K4	4
C115	Same as C103	V103 detector filter	-	-
C116	Capacitor, Fixed; Dry Electrolytic; 5 uf 50 WVDC	V103 amplifier section cathode bypass	42289-03	1
C117	Capacitor, Fixed; Dry Electrolytic; four sections 20 uf each 450 WVDC	c/o C117A, C117B, C117C C117D	42205-08	1
C117A	(p/o C117) Listed for reference only	V101, V102 plate decoupling	-	-

AMPLIFIER UNIT PARTS LIST (cont)

Symbol Number	Description	Function	Lear Part Number	Qty per Equipment
C117B	(p/o C117) Listed for reference only	V108, V109 screen decoupling	-	-
C117C	(p/o C117) Listed for reference only	V110, V111 cathode filter	-	-
C117D	(p/o C117) Listed for reference only	V110, V111 cathode filter	-	-
C118	Same as C103	AVC decoupling	-	-
C119	Capacitor, Fixed; Paper Dielectric; 0.1 uf ±20% 400 WVDC	DC blocking	91079-104-M4	1
C120	Same as C103	AF coupling, V104 to V105	-	-
C121	Same as C103	AF coupling, V104 to V106	-	-
C122	Capacitor, Fixed; Dry Electrolytic; 500 uf 25 WVDC	V105 and V106 cathode bypass	42289-11	1
C123	Same as C103	Optional microphone input coupling to AF amplifiers	-	-
C124	Same as C103	Matches T101 to IF link impedance	-	-
C125	Same as C112	V103 amplifier section plate bypass	-	-
C126	Capacitor, Fixed; Dry Electrolytic; 1000 uf 30 WVDC	Y101 noise filter between L101 and ground	96213-04	1
C127	Capacitor, Fixed; Paper Dielectric; 0.5 uf 50 WVDC	p/o T106 output pi filter	63353	2
C128	Same as C127	p/o T106 output pi filter	-	-
C129	Capacitor, Fixed; Paper Dielectric; 0.05 uf 1600 WVDC	Y101 buffer	702289-01	1
C130	Same as C103	p/o V110, V111 plate filter	-	-
C131	Same as C103	p/o V110, V111 plate filter	-	-
C132	Same as C114	Plate coupling between amplifier section of V103 and compass output circuits	-	-
C133	Capacitor, Fixed; Paper Dielectric; 4700 uuf ±10% 400 WVDC	p/o low pass filter at V107 amplifier grid	91079-472-K4	2
C134	Same as C114	AF coupling, V107 to V108	-	-
C135	Same as C114	AF coupling, V107 to V109	-	-
C136	Capacitor, Fixed; Paper Dielectric; 0.047 uf ±10% 600 WVDC	T105 primary power factor correction for loop motor, between V108 pin 5 and V109 pin 5	91079-473-K6	1

AMPLIFIER UNIT PARTS LIST (cont)

Symbol Number	Description	Function	Lear Part Number	Qty per Equipment
C137	Same as C103	T105 secondary low pass filter	-	-
C138	Same as C133	p/o low pass filter at V107 amplifier grid	-	-
C139	Capacitor, Fixed; Disc, Ceramic Dielectric; 0.02 uf min value 500 WVDC	ADF bypass between R131 and ground	90732-08	1
E101	Lug, Terminal	Soldering terminal on TB102	6778	10
E102	Same as E101	Soldering terminal on XV103	-	-
E103	Same as E101	Soldering terminal on XV107	-	-
E104	Same as E101	Soldering terminal on XV106	-	-
E105	Same as E101	Soldering terminal on XV104	-	-
E106	Same as E101	Soldering terminal on XV105	-	-
E107	Same as E101	Soldering terminal on TB104	-	-
E108	Same as E101	Soldering terminal on XV101	-	-
E109	Same as E101	Soldering terminal on XV102	-	-
E110	Same as E101	Soldering terminal on TB102	-	-
E111	Lug, Terminal	Cable clamp	50472	1
E112	Lug, Terminal	Soldering terminal	4745	2
E113	Same as E112	Soldering terminal	-	-
L101	Choke, RF	Y101 input and choke	63357	1
L102	Choke, Filter	Filters 115 cps reference voltage between T106 terminal 10 and P101 pin H	63731	1
L103	Choke, Filter	p/o V110, V111 plate filter	63352	1
P101	Connector, Receptacle; 22 pin, male	Connects amplifier to receiver, loudspeaker, A+ and loop motor; mates with P301	AN3102-28-11P	1
R101	Resistor, Fixed; Composition, 1 megohm ±10% 1/2W	AVC series filter impedance	57112	4
R102	Resistor, Fixed; Composition; 120 ohm ±10% 1/2W	V101 cathode bias	57065	2
R103	Not used	-	-	-
R104	Resistor, Fixed; Composition; 27,000 ohm ±10% 1/2W	V101 screen voltage dropping	57093	2
R105	Same as R102	V102 cathode bias	-	-
R106	Same as R104	V102 screen voltage dropping	-	-

AMPLIFIER UNIT PARTS LIST (cont)

Symbol Number	Description	Function	Lear Part Number	Qty per Equipment
R107	Same as R101	AVC series filter impedance	-	-
R108	Same as R101	V103 AVC detector section diode load	-	-
R109	Resistor, Fixed; Composition; 120,000 ohm ±10% 1/2W	V103 AF detector section diode load	57101	1
R110	Resistor, Fixed; Composition; 47,000 ohm ±10% 1/2W	V103 AF detector section diode load	57096	1
R111	Resistor, Fixed; Composition; 2,200 ohm ±10% 1/2W	V103 amplifier section cathode cathode bias	57080	1
R112	Resistor, Fixed; Composition; 680,000 ohm ±10% 1/2W	V103 amplifier section grid bias	57110	2
R113	Resistor, Fixed; Composition; 22,000 ohm ±10% 1/2W	V103 amplifier section grid-cathode bias	57092	1
R114	Same as R101	AVC series filter impedance	-	-
R115	Resistor, Fixed; Composition; 100,000 ohm ±10% 1/2W	V103 amplifier section plate load	57100	3
R116	Resistor, Fixed; Composition; 10,000 ohm ±10% 1/2W	V103 amplifier section plate load shunt	57088	1
R117	Resistor, Fixed; Composition, 2,700 ohm ±10% 1W	B+ filter	57347	1
R118	Same as R115	V104 grid dropping	-	-
R119	Resistor, Fixed; Composition; 1,800 ohm ±10% 1/2W	V104 cathode bias	57079	2
R120	Resistor, Fixed; Composition; 270,000 ohm ±10% 1/2W	V104 amplifier section plate load	57105	4
R121	Same as R120	V104 inverter section plate load	-	-
R122	Resistor, Fixed; Composition; 470,000 ohm ±10% 1/2W	V105 grid leak	57108	4
R123	Resistor, Fixed; Composition; 8,200 ohm ±10% 1/2W	V104 inverter section grid dropping	57087	2
R124	Same as R122	V106 grid leak	-	-
R125	Resistor, Fixed; Composition; 330 ohm ±10% 1W	V105 and V106 cathode bias	57336	1
R126	Same as R115	p/o optional microphone input filter impedance	-	-
R127	Resistor, Fixed; Composition; 470 ohm ±10% 1/2W	V105, V106 cathode bias for optional modulator use	57072	1

AMPLIFIER UNIT PARTS LIST (cont)

Symbol Number	Description	Function	Lear Part Number	Qty per Equipment
R128	Resistor, Fixed; Composition; 100 ohm ±10% 2W	Voltage dropping between P101 pin M and RL101 (used only on 28V units equipped with Advance relay for optional modulator use)	57620	1
	Resistor, Fixed; 50 ohm 5W	(used only on 28V units equipped with Potter Brumfield relay for optional modulator use)	-	
R129	Resistor, Fixed; Composition; 1,200 ohm ±10% 1W	Y101 output loading	57343	2
R130	Not used	-	-	-
R131	Same as R112	p/o low pass filter in V107 amplifier section grid circuit	-	-
R132	Resistor, Fixed; Composition; 47 ohm ±10% 1W	Y101 input voltage dropping	57326	1
R133	Same as R129	Y101 output loading	-	-
R134	Resistor, Fixed; Wire Wound, 1 ohm ±10% 7W	T106 primary current limiting	63350-01	2
R135	Same as R134	T106 primary current limiting	-	-
R136	Resistor, Variable; Composition; 2 megohm ±20% 1/4W	Adjusts phase of ADF signal on V107 amplifier section grid	63200-21	1
R137	Same as R122	p/o low pass filter at V107 amplifier section grid	-	-
R138	Same as R119	V107 cathode bias	-	-
R139	Same as R120	V107 amplifier section plate load	-	-
R140	Same as R120	V107 inverter section plate load	-	-
R141	Same as R122	V108 grid leak	-	-
R142	Same as R123	V107 inverter section grid bias	-	-
R143	Same as R122	V109 grid leak	-	-
R144	Resistor, Fixed; Composition; 220 ohm ±10% 1W	V108 and V109 vilament voltage dropping	57334	1
R145	Resistor, Fixed; Wire Wound; 0.85 ohm ±10% 3W	Filament voltage dropping (14 V operation only)	59300-01	1
	Resistor, Fixed; Wire Wound; 3.4 ohm ±10% 3W	Filament voltage dropping (28 V operation only)	59300-05	
R146	Resistor, Fixed; Wire Wound; 3,000 ohm ±10% 10W	V108 and V109 grid dropping	63735	1
R147	Resistor, Fixed; Composition; 33,000 ohm ±10% 1/2W	V104 grid leak	57094	1

AMPLIFIER UNIT PARTS LIST (cont)

Symbol Number	Description	Function	Lear Part Number	Qty per Equipment
R148	Resistor, Fixed; Wire Wound; 82 ohms ±10% 3W	V201 filament dropping (28V Beat Frequency Oscillator models only)	59300-10	1
R149	Same as R122	p/o V104 amplifier section grid low pass filter	-	-
RL101	Relay, DPDT; 12V 100 ohm (Advance) 12V 60 ohm (Blumfield)	Audio output switching relay for optional amplifier modulator use only	16419	1
T101	Transformer, IF	Coupling between IF link and V101	97606	3
T102	Same as T101	IF coupling between V101 and V102	-	-
T103	Same as T101	IF coupling between V102 and V103	-	-
T104	Transformer, AF	Audio output transformer	63002	1
T105	Transformer, AF	ADF output transformer	63698	1
T106	Transformer, Vibrator	Vibrator output coupling to rectifier tubes V110 and V111, 115 cps reference voltage to modulation transformer T14 and loop motor fixed phase winding	63937	1
TB101	Terminal Strip; 3 tie	Soldering terminals	4929	1
TB102	Terminal Strip; 8 tie	Soldering terminals	42198-08	1
TB103	Same as TB102	Soldering terminals	-	-
TB104	Terminal Strip; 5 tie	Soldering terminals	42198-05	1
TB105	Terminal Strip; 5 tie	Soldering terminals	2756	1
V101	Electron Tube; 6BJ6	First IF amplifier	62995	2
V102	Same as V101	Second IF amplifier	-	-
V103	Electron Tube; 12AT6, triode, twin diode	Detector, AVC, first AF amplifier	54936	1
V104	Electron Tube; 12AX7, twin triode	Second AF amplifier and phase inverter	62306	2
V105	Electron Tube; 6AK6	Audio output amplifier	62996	4
V106	Same as V105	Audio output amplifier	-	-
V107	Same as V104	First ADF amplifier and phase inverter	-	-
V108	Same as V105	ADF output amplifier	-	-
V109	Same as V105	ADF output amplifier	-	-

AMPLIFIER UNIT PARTS LIST (cont)

Symbol Number	Description	Function	Lear Part Number	Qty per Equipment
V110	Electron Tube; 6X5GT, twin diode	High voltage rectifier	16618	2
V111	Same as V110	High voltage rectifier	-	-
XV101	Socket, Miniature Tube; 7 pin	Mounts V101	62244-06	7
XV102	Same as XV101	Mounts V102	-	-
XV103	Same as XV101	Mounts V103	-	-
XV104	Socket, Miniature Tube; 9 pin	Mounts V104	62234-07	2
XV105	Same as XV101	Mounts V105	-	-
XV106	Same as XV101	Mounts V106	-	-
XV107	Same as XV104	Mounts V107	-	-
XV108	Same as XV101	Mounts V108	-	-
XV109	Same as XV101	Mounts V109	-	-
XV110	Socket, Tube; 8 pin	Mounts V110	53656	2
XV111	Same as XV110	Mounts V111	-	-
XY101	Socket, Tube; 4 pin	Mounts Y101	53945	1
Y101	Vibrator, Nonsynchronous	Converts A+ to 115 cps AC at T106, pins 1 and 6	63877-02	1
Series 200 - 299	Beat Frequency Oscillator Assembly	p/o ADF-12D4 only; provides for CW reception	59352	1
C201	Capacitor, Fixed; 390 uuf	T201 tuning; p/o T201	-	-
C202	Capacitor, Fixed; 470 uuf	DC blocking; p/o T201	-	-
C203	Capacitor, Fixed; 27 uuf	Beat Frequency Oscillator coupling to V103 detector diode plate; p/o T201	-	-
C204	Capacitor, Fixed; Paper Dielectric; 10 uuf ±20% 600 WVDC	Beat Frequency Oscillator coupling to V103 detector diode plate	42353-201A	1
R201	Resistor, Fixed; 15,000 ohm ±10% 1/2W	V201 grid dropping; p/o T201	-	-
T201	Coil Assy, BFO	V201 oscillator circuit	96422	1
V201	Electron Tube; 12AT6, triode, twin diode	BFO amplifier	54936	1
XV201	Socket, Miniature Tube; 7 pin	Mounts V201	62244-09	1

ANTENNA UNIT PARTS LIST

Symbol Number	Description	Function	Lear Part Number	Qty per Equipment
	Antenna, Loop; 7- 7/16 lg X 7 w X 6- 3/8 in. h includes motor, autosyn, receptacles, hermetically sealed. Does not include baseplate, connector strip or fairing	Antenna parts are listed in figure 3-8	700939-01 (Model 2320A) 700939-02 (Model 2320B) 700939-03 (Model 2320C)	1

SWITCH AND CONNECTOR KIT PARTS LIST

Symbol Number	Description	Function	Lear Part Number	Qty per Equipment
Series 300 - 399	Kit, Switch and Connector (ORIENTER ADF-12D3 without Beat Frequency Oscillator 14 VDC at 5.8 amps or 28 VDC at 3.1 amps	c/o connectors, switches and mounting hardware for installing the ORIENTER	701304-01 (14V) 701304-02 (28V)	1
	Kit, Switch and Connector (ORIENTER ADF-12D4 with Beat Frequency Oscillator) 14 VDC at 5.8 amps or 28 VDC at 3.1 amps		701304-03 (14V) 701304-04 (28V)	
	Kit, Loop Installation (ORIENTER, ADF-12D3 and ADF-12D4); this kit forms part of switch and connector kits 701304-01, -02, -03, -04, and parts of the two kits are listed together below	Loop mounting hardware and accessories	97551 (note description column)	1
A301	Tuner Cover Assembly	Dust cover	703272	1
A302	Housing, Loop Antenna	Loop assembly and corrector strip fairing	700840	1
A303	Plate, Reinforcing	Loop and corrector strip mounting base	700879	1
A304	Corrector Strip Assembly	Corrects quadrantal error due to fuselage "antenna" effect upon loop reception	700878	1
A305	Corrector Strip Subassembly	p/o A304	702205	1
E301	Lug, Terminal	Soldering terminal	3445	1
F301	Fuse; 4AG, 10 amp	Line fuse	62685-02 (14V only)	1
	Fuse; 4AG, 5 amp	Line fuse	95636-04 (28V only)	
H301	Clamp, Cable	Holds cable in connector P301	AN3057-16	1
H302	Clamp, Cable	Holds cable in connector P302	AN3057-6	2

SWITCH AND CONNECTOR KIT PARTS LIST (cont)

Symbol Number	Description	Function	Lear Part Number	Qty per Equipment
H303	Same as H302	Holds cable in connector P304	-	-
H304	Screw, Rd Hd, Machine; no. 6-32 by 7/8 in. lg cad plated steel		AN515-6-14	4
H305	Clamp, Cable	Holds cable in connector P303	AN3057-4	1
H306	Screw, Bd Hd, Machine; no. 6-32 by 3/8 in. lg cad plated steel		Q5413-06-06	4
H307	Nut, Self Locking; no. 6-32 by 0.312 across flats by 0.172 in. thick aluminum		AN365D-632	4
H308	Screw, Truss Hd, Machine; no. 6-32 by 1/2 in. lg cad plated steel		Q5813-06-08	18
H309	Nut Plate, Self Locking; no. 6-32 by 0.969 lg by 0.391 wd by 0.234 in. h aluminum		AN366-DF632	18
H310	Rivet, Solid; Countersunk 100°; precision head, 5/16 by 3/32 in. dia aluminum		AN426-3-5	54
H311	Nut, Self Locking; no. 6-32 by 0.312 across flats by 0.172 in. thick steel	Mounts E302	AN365-632	1
H312	Screw, Fillister Hd, Machine; no. 6-32 by 7/16 in. lg cad plated steel	Mounts E302	AN500-6-7	1
H313	Screw, Flat Hd, Machine; no. 6-32 by 3/8 in. lg cad plated steel	Mounts L301	AN507-632-6	1
H314	Screw, Rd Hd, Machine; no. 8-32 by 1/2 in. lg cad plated steel	Mounts loop antenna	AN515-8-8	4
L301	Coil Holder Assembly	Corrects quadrantal error	700868	1
P301	Connector, Plug; 22 pin, female	Connects amplifier with receiver, loudspeaker, A+ and loop motor; mates with P101	AN3106B-28-11S	1
P302	Connector, Plug; 4 pin, female	Connects indicator to loop antenna	AN3106-14S-2S	1
P303	Connector, Plug; 1 pin, male	Connects P307 to J1; p/o A301, tuner cover	61652	1
P304	Connector, Plug; 15 pin, female	Connects receiver to amplifier, sense antenna and loop antenna, mating with P1; p/o A301, tuner cover	42321-215	1
P305	Connector, Plug; 2 pin, female	Connects loop antenna slip rings to receiver	AN3106-10SL-4S	1

SWITCH AND CONNECTOR KIT PARTS LIST (cont)

Symbol Number	Description	Function	Lear Part Number	Qty per Equipment
P306	Connector, Plug; 6 pin, female	Connects loop motor to amplifier and loop synchro transmitter to indicator	AN3108-14S-6S	1
P307	Connector, Plug; 1 pin, male	Connects sense antenna lead to P303	PL-259	2
P308	Same as P307	Connects sense antenna lead to sense antenna	-	-
R301	Resistor, Fixed; Wire Wound; 2.1 ohm ±10% 3W	Filament voltage dropping; between S301 and P304 pin 3 (14V operation only)	59300-03	1
	Resistor, Fixed; Wire Wound; 8.4 ohm ±10% 3W	(28V operation only)	59300-08	
S301	Switch, SPST	A+ ON-OFF; connects A+ to P304 pin 3 and A+ to P301 pin M	62560	1
S302	Switch, SPDT	BFO ON-OFF; connects P301 pin U to P304 pin 14 (Beat Frequency Oscillator models only)	70573	1
W301	Wire, Twin Co-ax	Loop lead-in	62631	27-1/2'
W302	Wire, Twisted pair; 72 ohm characteristic impedance	IF link	63820-22-0-5	40'
W303	Cable, Co-axial	Sense antenna lead-in; connects P307 to P308	RG-114/U	20'
XF301	Fuse Holder	Mounts F301	33975	1

LEAR INC., LEARCAL DIVISION 3171 S. BUNDY DRIVE, SANTA MONICA, CALIFORNIA, U